10

THE PRINCIPLES

AND

PRACTICE OF PHOTOGRAPHY

FAMILIARLY EXPLAINED;

BEING A

Manual for Beginners,

AND REFERENCE BOOK FOR EXPERT PHOTOGRAPHERS.

COMPRISING

THE COLLODION PROCESS;

PRINTING AND TONING.
THE BEST DRY-PLATE PROCESSES.
LIGHT, AND HOW TO USE IT.
HOW TO MAKE A GOOD GLASS ROOM.
THE DIAPHANOTYPE.
SARONY'S PHOTO-CRAYONS.
IMPROVED IRON DEVELOPERS.
STEREOSCOPIC PICTURES.
BROMIDE OF SILVER PROCESS.
COPYING AND ENLARGING.
THE IVORYTYPE.
MAGIC LANTERN TRANSPARENCIES.
LIFE-SIZE PORTRAITS.
CABINET PICTURES.

CARBON PRINTING.

DEFECTS, FAILURES, AND REMEDIES,

&c. &c. &c.

BY JABEZ HUGHES,

PHOTOGRAPHER TO THE QUEEN, H.R.H. THE PRINCE OF WALES, AND THE ROYAL FAMILY.

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PREFACE TO THE NINTH EDITION.

In this manual the Author has endeavoured to give simple and clear directions for producing photographs. He has adopted the familiar style, as admitting of the plainest and most homely language. The pupil has always been supposed to be at his elbow. The object has been to remove as many difficulties as possible from his path, and to render the commencement interesting. There has been no desire, however, to hide from the pupil the real difficulties that he may encounter in practice; he is rather prepared for them, and instructed how to meet some and avoid others.

Part I. is therefore confined to elementary manipulations and simple directions; many instructions and suggestions are more fully explained at a later part of the book, when it may be supposed, that, with more extended experience, he may be better able to appreciate them.

Part II. is confined to dry-plate photography. This

is a subject quite distinct, and is fitted more for the use of amateurs and professionals. The general principle of all the dry processes is distinctly stated, and the most useful of them are fully described.

Part III. is devoted to subjects that imply a full knowledge of practical details. In this part the writer has compressed much of the matter that he has contributed to photographic literature in the form of papers to various photographic societies, and to the journals devoted to the art. His constant object, whether addressing the tyro or the experienced photographer, is to beget a love for the art and a desire for its improvement. The progress that has been made by photography is mainly due to the interchange of knowledge among those who practise the art, and, actuated by the same feeling, the larger the circle becomes, the greater will be the security that this fascinating art will arrive at still higher degrees of advancement.

RYDE, *May*, 1870.

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ENGLISH WEIGHTS AND MEASURES.

Troy or Apothecaries' Weight.	Avoirdupois Weight.
20 grains = 1 scruple.	
60 „ = 1 drachm.	27½ grains = 1 drachm.
480 „ = 1 ounce.	437½ „ = 1 ounce.
12 ounces = 1 pound.	16 ounces = 1 pound.

FLUID MEASURE.

60 minims = 1 drachm.
480 „ = 8 „ = 1 ounce.
160 drachms = 20 ounces = 1 pint.
8 pints = 4 quarts = 1 gallon.

FRENCH WEIGHTS AND MEASURES.

1 gramme *weighs* nearly 15½ English grains (15·433).

1 „ = 10 decigrammes = 100 centigrammes = 1000 milligrammes.

1 kilogramme = 1000 grammes = nearly 2¼ lbs. avoirdupois (2·247).

1 litre is equal to nearly 35¼ fluid ounces (35·2).

1 cubic centimetre is equal to nearly 17 minims (16·896).

1 *millimetre* measures in length 0·0393 inches.
1 *centimetre* „ „ 0·393 „
1 *decimetre* „ „ 3·937 „
1 *metre* „ „ 39·370 „

HOW TO LEARN PHOTOGRAPHY.

A FEW WORDS TO THE BEGINNER.

We are about to commence a course of familiar instruction in Photography. You are to be the pupil, and I am to be the teacher. You wish to know how to take a picture by the action of light, and I am willing to instruct you; if you obey my advice and follow my instructions you will soon acquire that knowledge. You must not however be too impatient; you must try to understand the reason why the various operations are performed. I wish you to be interested in each stage of the process of taking a photograph, so that you may be able to explain to any intelligent person the various steps as you proceed.

The first important fact I wish to impress on your mind is, that the taking of a photograph consists in a series of delicate chemical experiments. If these are all carefully performed a successful photograph will be produced; but if from carelessness or ignorance any of the intermediate portions are badly executed, the final result will be correspondingly unsuccessful.

You must therefore cultivate the habit of carefully observing all your operations; you must be exact in measuring and weighing your various chemicals, until you have experience enough to know the amount of margin that

judgment will permit. You must also be very careful in using only clean vessels to hold the different solutions; the cleanliness that is ordinarily considered sufficient, will rarely do for chemistry.

There are many ways of producing a photograph; yet the particular process I am going to teach you is so much superior, that I shall take no notice of the others. It is called the "Collodion Process," because collodion plays an important part: this substance is a glutinous fluid formed by dissolving gun-cotton in a mixture of Ether and Alcohol. The photographs taken by the collodion process may be either *Positives* or *Negatives*. The meaning of these terms will be fully explained when we describe the processes. We shall not be able to make much progress until we have the

APPARATUS AND CHEMICALS NECESSARY.

THE first thing is to obtain a Set of Apparatus. Beginners too frequently get a common cheap one, and are surrounded with unnecessary difficulties from this cause alone. There is no reason that the apparatus should be very expensive, but each article should be good of its kind. The quantity you will require will depend on the branch to which you devote yourself. Should you wish to be equally well furnished for producing Portraits and Landscapes, a full equipment will be necessary. The following comprises a complete set, equally adapted for all purposes, together with a list of Chemicals, the quantities being calculated for plates $8\frac{1}{2}$ by $6\frac{1}{2}$ inches, or "*whole-plate*" size. Should there be more articles enumerated than you think you will require, you must consult with some photographic friend, or explain to

the person from whom you make your purchase, the description and size of pictures you wish to take, and you will be advised what articles to omit.

A Lens for Landscape and Architecture.
A well-made accordion-body Landscape Camera.
A light, strong, but portable Tripod Stand for ditto.
A travelling Glass Bath with water-tight top.
A portable Dark Tent, for working in the open air.
A Portrait Lens, fitted with Central Diaphragms.
A substantial square Mahogany Camera for in-door work.
A strong, well-made Camera Stand for in-door work.
A Head-rest for attachment to Chair Backs.
A strong Iron ditto for Standing Figures.
Three Plate Boxes, 24 grooves, to suit the sizes of the Camera.
Patent Plate-Glasses to fill the above.
Set of Scales and Weights, with Glass Pans.
1 Plate-cleaning Holder.
1 or more stout Oak Printing-Frames.
1 Pneumatic Plate-holder for large Plates.
2 or more Porcelain Dishes.
1 Gutta-percha Tray, to be used for Hyposulphite of Soda only.
1 large and 1 small Glass Funnel.
1 Gutta-percha Funnel, medium size.
1 each 20 oz., 5 oz., 2 oz., and 60 minim, Graduated Glass Measure.
1 four oz. tall Graduated Collodion Bottle.
1 Diamond for cutting Glass Plates.
1 Silver-bath Meter, for estimating the Strength of Silver Solutions for Printing.

A few Glass Stirring Rods.
Linen Cloths and clean Chamois Leather.
A few wide and narrow-mouthed Bottles.
A black velvet Focussing Cloth, about one yard square.

THE LIST OF CHEMICALS NECESSARY.

20 oz. Bromo-iodized Negative Collodion.
20 oz. Positive Collodion.
5 oz. Recrystallized Nitrate of Silver.
1 oz. Iodide of Potassium.
1 oz. Pyrogallic Acid.
1 oz. Citric Acid.
1 lb. Protosulphate of Iron.
4 oz. Nitrate of Potash.
1 lb. Hyposulphite of Soda.
15 gr. Chloride of Gold.
4 oz. Kaolin.
4 oz. Cyanide of Potassium.
5 oz. Glacial Acetic Acid.
5 oz. Alcohol.
1 bottle Crystal Varnish.
1 ditto Spirit do.
4 oz. Acetate of Soda.
1 oz. Bicarbonate do.
1 bottle Black Varnish.
1 ditto Plate-cleaning Solution.
1 quire highly Albuminized Paper.
1 „ white Blotting Paper.
1 book Litmus Paper.
1 packet of large round Filter Papers.
1 ditto small.

It is not necessary that you should get the chemicals in exactly the quantities given above, and for sizes below 8½ by 6½ in. smaller portions will do; yet it is not well to begin with too small a stock, as from your inexperience you will be very apt to spill and waste a quantity at first; and if you reside in a country district you may experience a difficulty in obtaining articles sufficiently pure for your use. As a rule, it is better to buy them of those persons who supply photographic materials, from whom you will obtain them cheaper and better than from local chemists and druggists.

Having selected your Apparatus and Chemicals, the next thing is to prepare a room in which to conduct your principal operations. This is technically called a *dark room*, though, except in a chemical sense, there is no reason that it should be very dark.

HOW TO PREPARE THE DARK ROOM.

Many persons imagine that any cupboard, or out of the way corner, will do to prepare plates in: this is a mistake, and if you can select a room sufficiently large in which you can move about freely, it will be much better than being cooped up and crippled in your actions. Moreover, in warm weather, the fumes from the chemicals will be injurious to your health, if the chamber be too small and ill-ventilated. All articles that can be spared should be removed from the room, and none allowed to remain that can be injured by chemicals being spilt upon them. It should be kept very clean, for dust and dirt are great enemies to good photography. Oilcloth or bare boards are best for the floor, not carpet. A convenient

range of shelves should be made round the room, and some hooks provided for hanging cloths and towels on.

It is a remarkable circumstance that the chemical force that accompanies Light, by means of which photographs are taken, resides mainly in the blue, and scarcely at all in the yellow rays; and photographers ingeniously take advantage of this fact by illuminating their "dark" rooms with this non-photographic light, and thus see how to prepare their most sensitive plates. Every aperture and chink that admits white light must be carefully stopped up.

If there be more windows than one, they should be blocked out, and the remaining one must be covered with three folds of yellow calico; or, it will be better still to have a hinged frame made to cover the window, and to glaze this frame with dark yellow or orange glass, so that you can have yellow or white light in your room at will. If a window is not obtainable, a gas light, a lamp, or even a candle may be used, if a yellow glass be provided. An ordinary moderator lamp, with a yellow paper screen over it, makes a very fair light for the *dark* room. Persons usually make the room for preparing their plates too dark. This is a mistake; at least sufficient light should be admitted to enable you to see what you do, but it is important that this light be quite yellow. Should you commit the error of admitting too much light, your pictures will be imperfect, but you will find under the head of "Defects, Failures, and Remedies," on page 39, the proper method of proceeding in such a case.

Near the window or lamp, a strong shelf or table should be placed, on which to place the bottles which you will require; and closely at hand you must have a supply of water. If you can have the water laid on, with regular tap and sink, your

arrangements will be perfect; failing this, you may have a cask or other vessel with a tap in it, filling it up with water as you need; or, on an emergency, use a jug, and a pail to receive your slops. Have a towel and soap conveniently placed to wash your hands with.

Be sure and provide some effective means for ventilating this room. When you are not at work in it let the door and window be freely open so as to encourage draughts of air through. In winter this room should be heated by a fire, or stove, as the photographic chemicals never work properly at a low temperature. Do not use a gas stove for this purpose; next to a charcoal stove a gas one is the most poisonous and dangerous that can be employed to warm an apartment, and especially a photographic dark room.

HOW TO BEGIN WORK.

Your apparatus being secured and your room prepared, you are now ready to make a commencement, and your natural desire will doubtless be to make your first attempt in photography by taking a portrait.

But as you are a beginner, you should commence with the easiest thing, and to take a good portrait is one of the most difficult things in photography. The proper proceeding is to set up a plaster cast, engraving, porcelain statuette, or similar still-life object, and practise upon it, being prepared for many failures arising from your ignorance and clumsiness, before you attempt portraiture. You should try picture after picture, noticing carefully the faults you commit in one, so as to avoid them in the next.

In this way, by patience, observation, and practice, you

will speedily gain such experience as will make your new occupation a pleasure. Above all things, do not expect to produce good pictures all at once ; and be not discouraged with failures, but try to understand why you fail.

In setting up an inanimate object to copy, the risks of failure are less than when you have a person to sit, for it will not move nor alter its expression, nor make remarks if you do not succeed. When brother Tom, or friend Harry is called in, the case will be different ; they will be full of fun and jokes, will most likely move at the critical moment, and say disparaging things when they find the picture a failure. All this will confuse you, and cause you to omit things you ought to have done, and do abundance of things you ought not to have done, and dishearten you in your early progress.

You had better, therefore, set up a plaster cast bust—one painted stone-colour will be best—such as those of Shakspeare, which are so abundant, and, using this as a model, work frequently at it until you have sufficient mastery of your instrument and materials to produce, with moderate certainty, a passably good picture ; then you may proceed to portraiture.

Place your object in a good light : a glass-house built for the purpose is the best ; but this you may not at present be able to obtain. Should you have it in your power to erect a proper photographic studio, you will find on page 78 ample directions. Your early experiments may be made in a garden, or a greenhouse, or a well-lighted apartment will suit, if you use a white screen—a sheet thrown over a clothes-horse will do—to reflect light upon the shaded side. A background may be formed by hanging some quiet drapery a little distance behind your object.

HOW TO ARRANGE YOUR APPARATUS.

Your plaster bust, or similar object, being placed in a good light—which however should not be too strong, nor too evenly cast in all directions—the endeavour should be to throw a slight shade on one side which will permit the true modelling to be seen. I shall not trouble you at this early stage about the "arrangement of light" so as to represent your objects in the most pleasing manner; you will find an article on page 75 devoted to it. This you may read over at your leisure, and presently you will understand it better. But even at this early stage I must remind you that the true keystone to successful photography depends on no one thing so much as the "management of the light."

Now get out your portrait lens, and after wiping carefully the surfaces of the glasses with a clean silk handkerchief or chamois leather, screw it on to your portrait camera, and place them both on your heavy camera-stand opposite to your object. The ground-glass of your camera should have the sizes of the glass plates marked on it in squares, corresponding to the holders in your dark slide. Place your stand and camera so that the lens is opposite to about the centre of your plaster bust, and move the stand and camera backwards or forwards until the image of the object is of the size, and occupies the place on your ground-glass that you wish the image to do on the plate you are going to use, remarking that the nearer the camera is to the object, the larger the image will be, and *vice versâ*. Lay the black velvet focussing-cloth on the camera; put your head under the cloth, and you will then more clearly see the image on the ground-glass. Slide the inner body of the camera in or out until the image is

seen quite distinctly, then fix the camera with the screw provided. While your head is still under the focussing-cloth, pass your hand round to the lens, and move the rack backwards and forwards till you find the point at which it is most distinct.* It is then said to be "in focus," or "sharp," and in this state the camera and object may remain until we have prepared a sensitive plate. The first kind of photographs I shall instruct you to produce is known as a "glass positive." It is not the most useful kind of photograph, neither is it so frequently produced as it used to be, yet it serves as an excellent introduction to the production of "negatives"—the most important kind of photograph—as the manipulations are so similar. Moreover, the "glass positive" is more quickly produced and the final result more easily seen; it therefore suits the enthusiastic ardour of the beginner. Our next business then is to know

HOW TO PREPARE THE CHEMICAL SOLUTIONS FOR GLASS POSITIVES.

THE chemicals required for this process are—

Positive collodion.
Nitrate of silver solution.
Plate-cleaning do.
Developing do.
Fixing do.
Crystal Varnish.
Black do.

* These instructions for adjusting the focus apply to the common camera. The best kind of camera is provided with an endless screw arrangement, or a rack and pinion, by which the adjustment is made more easily and perfectly.

The positive collodion you will purchase ready prepared. When required for use, pour three or four ounces into the tall collodion bottle; and when you have done for the day, return what remains back into the stock-bottle, that it may settle. In this manner you can always use from a clear quantity, and avoid those spots and defects which arise from a turbid or unsettled collodion.

The nitrate of silver solution is one of the highest importance. To know how much solution to mix, fill your bath with water to within an inch of the top, and measure how much it holds. Suppose it to contain 25 fluid ounces;* as 35 grains of nitrate of silver to one fluid ounce of distilled water is the proper strength, 2 ounces of the nitrate will be required to form 25 fluid ounces of the necessary solution. Dissolve the silver in 4 ounces of distilled water, or boiled rain-water, then add 4 grains of iodide of potassium to it, shake it well for a few minutes, and add 21 ounces more of distilled water.

The solution will now be a pale milky colour, and will require filtering. Should it not run through quite clear, it must be re-filtered. Add one drop of pure nitric acid to every 3 ounces of nitrate solution, and then it will be ready for use.

* It is important to notice that in all photographic formulæ, where ounces of fluid are named, *fluid* ounces are meant, and that the glass measures are graduated for the purpose. When solids are named, *Apothecaries* weight is meant. But the materials are sold to you by *Avoirdupois* weight; and as the ounce of the latter is not so heavy as that of the former, this fact must be carefully remembered, or disputes with shopkeepers, and errors in mixing your solutions, will arise. The Apothecaries ounce weighs 480 grains, and the ounce Avoirdupois but 437½ grains. It is better, therefore, in mixing nitrate of silver solutions, to estimate the quantity required in *grains*, remembering that the purchased ounce of nitrate of silver will never contain more than 437½.

DEVELOPING SOLUTION.

Protosulphate of iron	150 grains.
Nitrate of potash	100 grains.
Glacial acetic acid...	½ ounce.
Water	10 ounces.
Nitric acid	5 minims.
Alcohol	½ ounce.

Dissolve the crystals, and if the solution be not quite clear, filter it, then add the alcohol and acids. It will keep good until it is a deep brown colour, when it ought to be rejected.

FIXING SOLUTION.

Cyanide of potassium	60 grains.
Water	6 ounces.

Dissolve, and it is ready for use.

Let each of these solutions be distinctly labelled, and cork the bottles when they are out of use. The fixing solution had better be legibly marked "Poison," to prevent any accidents. It should also be particularly kept out of reach of children, as it is a most deadly poison, despite its rather attractive smell.

The crystal and black varnishes that will be required when we finish the picture you can purchase all ready for use. Our next business, then, is to learn

HOW TO CLEAN THE GLASS.

Certain fixed sizes are used by photographers, and the glasses are sold cut ready for use.

The description of glass known as "Flatted Crown" is well suited for positives, but, before using, it requires carefully

cleaning. The sharp edges should be first removed with a "corrundum" file, or by drawing the edge of one piece over the edge of another; then lay the glass on a clean flat surface, or put it in a "plate-cleaning holder," and pour a few drops of the "plate-cleaning solution" in the middle. Rub it carefully over every part with a bit of clean soft rag: turn the glass over, and do the other side the same. Then polish each side with a clean cloth, and finish with a soft chamois leather kept expressly for this purpose. Now breathe on the glass; and if the breath deposits evenly, the plate is clean. If the plate, however, shows patches and marks, it must be re-cleaned. Let the edges be carefully wiped and the plate is ready for use. This amount of cleaning will, generally, be sufficient for new glasses, but when they have been used they require more labour. They must then be well washed under the tap, to get rid of all collodion and chemicals, and be wiped on cloths kept expressly for the purpose. No soap, only plain soda and water, must be used in washing these cloths. Should the plates have been varnished, they must be soaked for some hours in a saturated solution of washing soda, till the varnish and film come freely off. The glasses must then be well washed, and treated as already described. It is a good plan, when working, to have a dish of water at hand, and to place the spoilt pictures in it at once while they are wet, and at the end of the day to wash them all, and put them away clean. By thus not allowing the films to dry on the glasses, they are much easier cleaned, and fewer failures will arise from dirty glasses.

Collodion is a good material for cleaning glasses when they are not very dirty. Pour a few drops on the glass, and well rub it with a clean cloth, and you will entirely remove all

grease. A hint may thus be taken how to use up waste collodion.

The glass plate being cleaned—and it is a good plan to clean a dozen or so in advance—it is ready to receive the collodion.

TO COLLODIONIZE THE PLATE.

Remove the stopper from the bottle, and wipe from the lip any dust or dry film adhering; and, holding the plate horizontally by one corner with the thumb and finger of the left hand, pour steadily into the middle of the plate as much collodion as will half cover it. Then gradually incline the plate so that the collodion flows to each corner, not allowing it quite to touch the thumb, nor to flow a second time to any part; then steadily pour back the excess from one corner into the bottle, and while the plate rests on the mouth of the bottle, move the plate backwards and forwards to prevent the collodion setting in crapy lines. Perform this operation coolly and steadily, and try to avoid spilling any of the collodion. A little practice will make it easy. You must now shut your door and window, and see that only yellow light illuminates the room. When the collodion is set, —usually in a few seconds—the plate is ready to be immersed in the nitrate of silver bath. Lift the dipper up, and place the back of your plate on it—it will adhere by capillary attraction—and immerse plate and dipper into the bath solution with one steady dip, and continue to agitate the plate by moving it about in the bath for a few seconds. Take care it does not slip off the dipper. After agitating the plate, cover the bath over to keep the plate from light and dust. If there be the least hesitation or stop while the plate is being

immersed, there will be a line marked across the plate. To know how long to keep the plate before putting it in the bath, after it is collodionized, is a point that you will gain by experience; but it depends on many circumstances, such as the nature of the collodion and the temperature; but this rule will guide you; if you put the plate in too soon, streaks and marks will be formed, commencing from where it first touched the silver solution. If you do not immerse it soon enough, the part of the plate that has become too dry will be insensitive, and will show a transparent mark. By noticing these points, you can judge whether you have made an error in the time of immersion. The plate must remain in the bath in summer time about two minutes, and in winter from five to ten.

While the plate is in the bath, you must get ready your dark slide, and see that there are no dirty corners nor dust in it. Lift the plate up and down in the bath several times by means of the dipper, and the agitation of the solution will remove the oily-looking lines on the surface. Allow it to remain in the bath till all apparent greasiness is removed, and the film has become creamy-looking. Then take it off the dipper, and, handling it as carefully as possible—chiefly by the corner uncollodionized—let it drain for a few seconds on clean blotting-paper, and then lay it, collodion side downwards, into your dark slide, the silver wire corners supporting it by the four corners. Close up your dark slide, and your plate is ready for use.

You may now return to your plaster bust, and removing the ground-glass frame from the camera, insert the dark slide in the place. Cover the lens with the cap, raise the shutter of the dark slide, and gently remove the lens cap, so as not to

shake the camera: thus the light will be admitted to the sensitive plate. Experience can alone determine the length of the "exposure." The brilliancy of the light, colour of object, kind of lens, nature of collodion, time of day, and even the period of the year, are all modifying circumstances.

Suppose you allow ten seconds. Count the time exactly, and replace the cap on the lens. Next shut down the shutter of the slide, remove it from the camera, and take it into the dark room. Close the door, and noticing that no white light is admitted, remove the plate carefully from the dark slide. The nitrate solution that has accumulated at the bottom drain off with clean blotting-paper. Put about an ounce of developing solution into a clean measure glass, and holding the plate horizontally by the bare corner, collodion side upwards, pour steadily but quickly along the bottom edge of the plate sufficient to easily cover it; gently incline the plate to allow the developing solution to flow uniformly backwards and forwards. Watch the "coming out" of the image. The image will quickly appear; first the parts most strongly lighted will show themselves, next the shaded portions, and when these are fully out, turn off the solution, and wash the plate well, by allowing the water from the tap to flow over it for not less than one minute, or until all the greasy lines disappear.

Lay the plate in a shallow gutta-percha dish kept for the purpose, and pour quickly over it sufficient of the fixing solution to cover it. Directly the yellow film of iodide of silver is dissolved, the plate must be lifted out and well washed. When the plate goes into the fixing solution, white light may freely be admitted. The fixing solution

must be put back into its bottle, and may be used so long as it retains the power to dissolve the yellow film.

If the exposure be correct, and you have developed properly, you will now have a nice picture of your bust.* Your plate may be dried spontaneously or by heat. When dry, pour on the *glass* side the black varnish, just as you did the collodion, and drain off at one corner, taking care it does not flow over to the face of the picture ; or, better and easier, use a black varnish made expressly for the purpose, which is to be laid on with a brush, and which dries quickly, or may be assisted with heat. The collodion surface now requires varnishing, to protect it from atmospheric action. Remove carefully with a camel-hair brush any dust or dirt on the picture, and pour crystal varnish over it as you did the collodion. Drain it, and, when dry, your picture is finished, and ready to be mounted.

You have now passed through the various operations, and it only requires practice and observation to make them familiar to you. Having obtained this practice, the bust may be removed, and a friend being placed in its stead, you may, by applying the same manipulations, produce a portrait. Let him sit in an easy, graceful position, and, if necessary, steady his head by the use of the head-rest. Let him look at some dark object, and allow him to wink his eyes freely during the sitting, but caution him to be quite steady in all other respects.

You have to put all this information into practice, and you will understand how to take glass positives. These pictures,

* If the picture be not perfect, refer to the chapter on "Defects, Failures, and Remedies," page 39, for further instructions.

as you will now be aware, are formed of a film of collodion on a glass plate, with a backing of black varnish. They were at one time considerably in favour, but portraits on paper are now very much preferred. The production of a portrait on paper involves a double process, first making the *negative*, and then printing from it on to paper. My next instruction will be of a more important kind.

HOW TO TAKE NEGATIVES.

You must clearly understand the difference between a Negative and a Glass Positive. Every glass picture, to a certain extent, partakes of the nature of both; but a "glass positive" is a picture done at one operation, and complete in itself; whilst a Negative is not so much a picture as the means of producing one.

Glass positives are examined by reflected, negatives by transmitted, light; the one you hold *down* to look *at*, the other you hold *up* to look *through*; the former are black varnished to make them opaque; the latter clear varnished to give transparency. The one shows natural objects as they are—lights for lights and darks for darks; the other, just the reverse—faces, hands, and linen very dark, and black drapery quite clear. Hold a picture of each kind up to the light and look *through* them, the positive will appear thin and transparent, the negative dense and opaque; turn them down and look *at* them, the positive is clear and distinct, the negative misty and confused. The two kinds of pictures are so different that you must judge each by its own rules; for what is a fault in one, may be a merit in the other. In other words, a negative is a glass picture produced by somewhat similar

means to a positive, only that in the development a much thicker and denser deposit is formed.

In fact, the negative is to the photographer what the types are to the printer; and as the latter, you know, are arranged just the contrary of the impression that is taken from them, so must the photographer's negatives—his types—be the reverse of his prints. The analogy between the two processes is so considerable, that the production of paper pictures by the aid of negatives is always termed "printing."

It will be a great assistance to you, if you can obtain from some photographer a negative that you can keep by you, to compare with your own, until you have acquired experience to know how to judge for yourself.

The same apparatus serves for the production of negatives as positives, but some of the chemicals are different; those that you require are—

Bromo-iodized negative collodion.
Nitrate of silver bath solution.
Developing do.
Intensifying do.
Fixing do.
Spirit varnish.

The *Bromo-iodized Negative Collodion* is rather different in its preparation to positive collodion, and is better adapted for giving dense pictures. It is often supplied as plain collodion and iodizing solution. When so supplied it is made ready for use by mixing three parts by measure of the plain collodion to one of the iodizing solution. It is better to iodize the collodion a few hours before using, so that time be allowed for floating particles to subside.

Nitrate of Silver Bath Solution.—The same solution of nitrate of silver solution that you used for positives will not do for negatives.

Recrystallized nitrate of silver ... 2 ounces.
Distilled or boiled rain-water ... 25 „

Dissolve the silver in four ounces of the water; dissolve two grains of iodide of potassium in one ounce of the water, and add it to the four ounces of silver solution; agitate till the yellow precipitate formed first is dissolved. Add a few drops of a saturated solution of bicarbonate of soda, agitating well between each addition, until the silver solution becomes rather milky, then add the remaining 20 ounces of distilled water. Filter, and add half a drachm of glacial acetic acid, and your nitrate bath is ready for use. Fill it up from time to time with a plain solution of nitrate of silver, 50 grains to the ounce. More care is required in making up and keeping in correct working order the negative silver bath than the one for glass positives. Common nitrate of silver should not be used, only the best recrystallized. If time will permit, the solution after the carbonate of soda has been added, and before it is filtered, should be exposed to light, sunshine if possible, for a few days before being used. When it is out of use it may also be always kept freely in the light.

DEVELOPING SOLUTION FOR NEGATIVES.

Protosulphate of iron	150 grains.
Glacial acetic acid	½ ounce.
Alcohol	½ ounce.
Distilled water	10 ounces.

This solution gradually acquires a sherry colour, but its

quality remains equally good. It should be filtered before using.

FIXING SOLUTION.

Hyposulphite of soda	5 ounces.
Water	5 „

This solution may be used until it loses its power of dissolving the yellow iodide out of the film. It soon becomes discoloured, but that is of no consequence.

"Patent Plate" is the proper description of glass to use for negatives, as the "crown" is not flat enough. It requires the same careful cleaning as for positives. As it is more difficult to produce clean negatives than positives, you had better accustom yourself to use a glass one size larger than you require your picture to be, so that the defects, which occur on the margin of the plate, may not spoil your picture.

Pour the collodion on the plate, sensitize, drain, and place it in the dark slide carefully, and according to the same directions as given for glass positives.

The same difficulty occurs with negatives, in giving any rule for the length of exposure, as in positives ; the appearance of the plate during development is a useful guide, but negatives always require at least twice as long time of exposure in the camera as for positives. Be very careful, when your plate is in the dark slide, to keep it erect, and to handle it gently. Never knock the dark slide against anything, or the plate will be covered with abundance of spots from particles of dust and dirt falling on it.

You may experiment on your plaster bust for producing your first negatives, as you did for your glass positives, or if you have experience enough you may attempt a portrait.

During the exposure proceed the same as for a positive, making the requisite increased allowance for a negative. When in the dark room, take the plate out as carefully as before, and remove, with clean blotting-paper, the nitrate solution that has accumulated at the bottom; and holding it by the corner, pour over it the developing solution, and in a few seconds the image will appear. After a little experience you will be able to judge, by the manner in which the image makes its appearance, whether you have given the proper exposure in the camera.

If it start out at once, directly the developer has flowed over the plate, the exposure has been too long; but if the image comes out slowly and reluctantly, and you have difficulty in making the deepest shades appear, it has not been exposed long enough.

The happy medium between these two is the correct time. When this has been given, the image makes its appearance steadily and gradually,—first the high lights, next the light shades, and finally the deep shadows. Suppose it a portrait of a gentleman—the shirt-front, face, and hands are first seen; the light folds of the drapery next show themselves; and lastly, the details in the darkest parts. If it were a glass positive you were producing, you would have poured the developer off before these last were seen; but, being a negative, you must carry the development on until the whole of the details are clearly out, then pour the solution off the plate and wash it well. By holding your plate up to the light and looking through it, you will see the image as a negative,—the whites all dark, and dark portions nearly transparent; and if the picture appears in proper harmony, making allowance for reversed effects, the lighter

portions being nearly opaque, and the darker parts very clear —*but the whole picture full of gradations and half-tones, with scarcely any parts entirely opaque, and very few clear glass*— then the development is complete; if, however, the picture presents somewhat this appearance, but is deficient in opacity of deposit, or "density," it must be "intensified." To do this, pour over the plate as much as will comfortably cover it of the following—

NEGATIVE INTENSIFYING SOLUTION.

Pyrogallic acid	3 grains.
Citric do.	1 grain.
Glacial acetic do.	½ drachm.
Distilled water	1 ounce.

When this solution has thoroughly mixed with the water on the plate, pour it back into the measure-glass, and add a few drops of nitrate of silver solution to it (30 grains to the ounce of water), mix, and pour again over the plate; the image will speedily begin to intensify—that is, the silver will be deposited over the various parts where the light has acted. This intensifying must be continued until the parts of the negative most lighted have the requisite opacity.

This solution sometimes becomes turbid and muddy before the picture is dense enough. In such a case, pour it away, and renew with some fresh intensifying solution and silver, and proceed as before. This may be repeated many times, if needed, until the required effect is produced. Here is, perhaps, the most difficult thing you have to learn—to know how far to go, and when to stop; how to gain intensity enough to produce a vigorous negative, and yet to avoid making it too dense, and losing half-tone. As a rule,

beginners over-develop their positives, and under-develop their negatives.

But it is possible to intensify too much, and make the picture so dense that you cannot print through it. You must watch the kind of prints that different negatives produce, and when you find one that gives a brilliant yet soft image—for the real test of a negative is the kind of print it produces—study that negative well, observe the degree of opacity it has, and, keeping it as a standard, try and produce all others like it. In this way you can train and educate yourself to produce good negatives.

The development and intensifying being finished, wash the plate and lay it in the gutta-percha dish; pour the fixing solution over, and when the yellow iodide is dissolved out, give it a careful and copious washing; for if any of the hyposulphite of soda remain in the film, it will crystallize and spoil it.

Your picture now being washed, you may calmly examine it. If it appear as a moderately good but over-exposed positive, with a yellowish pearly tint, and on looking through it, shows abundance of half-tones, both in the opaque and transparent parts, you may consider you have a correctly-exposed and well-developed negative, and one from which you may anticipate brilliant prints.

If, however, the negative appear as a good positive, with brilliant blacks, but rather chalky whites, and on looking through if these latter are very dense without half-tone, and the former almost like bare glass, then your negative is defective, and will only produce a hard black and white print; the fault being that it was not long enough exposed in the camera.

Should it, however, appear as a very much over-exposed positive, the whole plate having a grey film over it, obscuring

the image, and on looking *through*, the details of the shadows are almost as intense as the white linen, and the whole picture is deficient in contrast, then it has been over-exposed.

The two instances I have pointed out are extreme ones: it is your object to avoid each; but of the two errors, under-exposure is the worst, for by careful printing you may get a passable proof from an over-exposed negative; but no dexterity will avail with an under-exposed one, and unfortunately, beginners' negatives, from their great desire to "work quick," have too frequently this latter fault.

I shall not burden you with any more instructions at this stage, on the production of negatives. There is a good deal more to be learnt when you have mastered what I have already taught. It does not do to attempt to take in too much at one time. I have now to call your attention to the last thing you have to do to complete your negative; viz., the varnishing.

HOW TO VARNISH THE NEGATIVE.

AFTER the plate has been well washed and dried, it is ready to varnish. If only a few prints are wanted, and you do not intend to keep the negative, you may use crystal varnish. If, however, you value your negative, and purpose producing many prints from it, the crystal varnish will not give sufficient protection, and you must use a spirit varnish, which will produce a much harder surface. To use this spirit varnish, warm the negative before a fire uniformly all over as hot as the back of the hand will bear, then pour the varnish on like collodion, drain off, and dry it with heat. The proper degree of heat to use will be acquired by a little experience; if the plate be made too hot, the varnish will not flow uniformly

over, but will run and dry into irregular streaks. If it be not hot enough, the surface will dry dull and dead. With the medium heat the film will dry with a hard, glassy surface. When cold, your negative is complete, and is ready to be printed from.

THE PRINTING OF PAPER PICTURES.

The remark has been made, that a *negative* is not so much a picture as the means of producing one; and your next proceeding is to use the negative to produce an impression on paper. This operation is called "printing," and the paper picture produced is termed a "print." There are two kinds of paper employed, plain and albuminized. The former yields a dull surface, like an engraving, and is chiefly used for pictures that have to be coloured; the latter has a glazed surface, and is the kind in general use for almost every kind of photograph, as it gives a more brilliant picture, and yields finer definition.

The apparatus necessary for printing are—

Printing-frames.
Porcelain dishes.
Gutta-percha dish.
Horn or box-wood pincers.
American pegs.

The materials required for the operation are—

Albuminized paper.
Plain salted do.
Nitrate of silver solution.
Chloride of gold.
Acetate of soda.
Hyposulphite of soda.

Albuminized Paper.—This material is troublesome to prepare, and you can purchase it ready for use much better than you can make it for yourself. There are two principal kinds, known as *Rive* and *Saxe.* The former is a French paper, and has the highest glaze and finest surface; but the latter, a German one, is the most uniform in its general texture.

Plain Paper.—Plain paper requires preparing, or "salting," before being ready for use, or it may be purchased already salted. It is not a difficult thing to "salt" your own paper. Procure some sheets of Saxe paper, and immerse them for five minutes, removing air-bubbles, in the following solution :—

Chloride of ammonium ...	... 100 grains.
Chloride of barium ...	... 100 „
Citrate of soda	... 20 „
Water	... 20 ounces.

Hang the sheets up to dry, and they are ready for the next operation. This may be performed in ordinary daylight.

A very simple method of using paper as "plain," that is, without glaze, is to employ the usual albuminized paper, but instead of using the glazed or albuminized side, to sensitize the back or plain side of the paper. No salting will be required, as sufficient is already in the paper with the albumen. Many samples of albuminized paper yield good plain prints, when useless if the albumen surface is employed. The albumen helps to produce a much richer picture than is usually to be obtained on plain paper.

Nitrate of Silver Solution.—Whether you intend to print on plain or albuminized paper, you must make a fresh silver solution, as the one you have used for your positives or negatives is not adapted for printing; neither will the one

you are about to make serve the former purposes; they must be kept for their separate uses. Measure how much fluid one of your porcelain dishes contains when filled half an inch high, and make so many ounces of plain nitrate of silver solution, 60 grains to the ounce. The crystals have simply to be dissolved, and the solution is ready for use. This solution becomes discoloured by use, but if you adopt the plan of keeping some of the white powder called Kaolin, an ounce or two, in the bottle in which you pour your solution after using, you will not be annoyed with your paper becoming darkened by the brown solution. Shake up the kaolin with the silver solution, and in subsiding the kaolin will carry down with it the colouring matter, leaving the silver solution clear. This solution rapidly loses its strength by being used, that is, the sheets of paper during the act of being sensitized rob the solution of much of its silver. Therefore each day you must observe if the silver solution is sufficiently strong. Some albuminized papers require a stronger silver solution than others, but unless you are advised otherwise you will be quite safe in using one of 60 grains to the ounce. The "Argentometer," or silver-bath tester, is a useful instrument to test the strength of your bath. Each time before using the bath immerse the Argentometer into it, and note the figure on the tube where the surface of the fluid touches, and it will indicate with sufficient accuracy for practical purposes the number of grains of nitrate of silver in each ounce of the solution. Thus if it stand at 30, 40, or 60, each ounce may be considered to contain so many grains of nitrate of silver. It is not sufficient that you originally mix your solution 60 grains to the ounce, but it must be continued so; and until you have experience you will

scarcely believe how quickly the act of sensitizing the paper abstracts the silver. If you adhere to the use of this little instrument it will keep you right, but never forget that unless your silver solution is kept to its proper strength you cannot obtain brilliant and vigorous prints. I should mention here that the Argentometer, though very useful for estimating the strength of the printing silver-bath, is not applicable to the negative-bath. That bath does not so rapidly change, and its exact strength is not so important.

Chloride of Gold.—This valuable substance is generally sold in bottles or tubes containing 15 grains. It is very deliquescent, and unless hermetically sealed, can only be kept in solution. Break your tube, and dissolve the contents in a bottle containing two ounces of water, and label it accordingly.

Hyposulphite of Soda.—Dissolve two ounces in sixteen ounces of water, and label the solution. Make a fresh quantity for every batch of prints.

HOW TO SENSITIZE THE PAPER.

FILL your dish to the depth of not less than half an inch with the nitrate of silver solution already named. Cut your paper to convenient sizes suitable to your negatives, and lay it, if it is albuminized paper, on its glazed or albuminized side downwards on the surface of the silver solution ; if it is plain paper, lay it on the smoothest side. When it has lain for about a minute, lift up one corner with the pincers, and if there are any air-bubbles, remove them ; replace the sheet, and allow it to remain five minutes on the solution, then lift it off, taking care no solution runs over the back, and suspend it, with an American peg, to a line, in a closet or other dark place, away from the light, where it can dry spontaneously.

It is then ready for use. Your paper ready, place your negative in the printing-frame, collodion side uppermost—be sure the glass is quite clean—and lay the paper on it, prepared surface downwards; put a few sheets of blotting-paper behind it; next put the hinged back in its place, and secure the whole tightly with the springs or other fastenings provided.

It is essential that the paper should be in very close contact with the negative to produce a "sharp" print, and you must observe that this pressure is uniform, to prevent breaking the negative.

Expose the frame to the light, and allow it to remain until the paper is printed. How long this operation will take depends on the power of the light and the density of the negative. In summer, a very short period is sufficient, say from ten minutes to half an hour; and in winter, a whole day or longer may be required. To know how the print is proceeding, undo the fastenings *on one side of the frame only;* and by lifting up half of the hinged back, you can, without disturbing the position of the negative and paper, examine the latter, and observe its progress. First, the general outline is marked; then, the deep shadows; next, the lighter shades; and finally, the delicate half-tones. By these latter you must be guided. You must print till they are not only clearly out, but a few shades deeper than you would like them, because in the subsequent operations they will become lighter, and unless you make this allowance your print, when finished, will not be deep enough. A little experience will tell you how dark you should print. In printing portraits, you must judge entirely by the *head;* get out all the half-tones clear and distinct, so that the ultimate picture shall show the features

nice and round, not buried in black shade from being over-printed, nor pale and flat from under-printing, but just such soft gradations as will make a pleasing likeness. This depth obtained, take it out of the printing-frame, and it is ready to be *toned* and *fixed*. The operations of preparing the paper, putting it into the printing-frame, examining it, and taking it out, together with the toning, should all be done either in yellow or very dull white light; for although the excited paper is not nearly so sensitive as collodion, yet a strong light, especially sunshine, will quickly spoil it for good printing.

HOW TO TONE THE PRINTS.

If you are producing several prints, you may wait till they are all ready, keeping those first done in a drawer or other place secluded from light; but they should be toned and fixed the same day they are printed, for although these operations may be deferred, the results are seldom so good. When ready, immerse them in a dish of clean water, removing air-bubbles, and move them about, that the water may get freely between; allow them to remain five minutes; pour the water away, and refill the dish, and again wash for another five minutes, moving them about as before; change the water a third time; this last time the water should only be slightly milky; if it is more than this, the prints must be further washed.

It is unfortunate that the print cannot be preserved with all the bloom and richness of colour that it shows when in the printing frame. Very much of this beauty is destroyed in the act of "fixing" the photograph. To compensate for this loss the print is passed through a process called

"toning;" this consists in depositing a thin layer of gold on the silver image, whereby the print is not only made more lasting, but also much more beautiful. There are several toning solutions, but I recommend the following as being a good one:—

TONING BATH.

Chloride of gold	... ...	7½ grains.
Acetate of soda	... ...	½ ounce.
Distilled water	... ...	40 ounces.

This bath may be mixed in the above quantity, as it will keep for a considerable time. It should be prepared a day or two before being used. When required for use, pour enough in a dish to well cover the prints. Take the prints from the last washing water, and immerse them one at a time; keep them moving about, and remove air-bubbles. Until you acquire experience, you had better not have more than three or four prints in at a time. They must be closely watched, for they speedily change from their reddish-brown to a purple tint; and if they have been printed deeply enough, the shades will pass to a purple black, while the whites will assume a delicate rosy hue. Some little experience is required to know when to take them out, but you may be guided by the general appearance as seen by looking *through* them, holding them up to the light. If they are purple when thus examined, they may be removed into a dish of clean water, to remain until they are all toned and ready to be fixed.

According to the depth to which you have printed, and the length of time they have been in the toning solution, so will the colour be. If you wish a rich chestnut brown, a very little toning will suffice; if you like a purple brown, tone

deeper ; and if a dark purple black, you must print and tone very deep. The colour of your prints will materially depend on your negatives. With a well-defined, soft, yet vigorous negative, you may produce any tone ; but from weak or hard negatives you cannot produce good pictures. Prints kept too long in the toning solution become cold, grey, inky, weak, and flat.

If you are attentive, you will quickly gain experience enough to get, with good negatives, almost any desirable tone by modifying the depth of printing and strength of toning. The time usually occupied in toning a print is from two to five minutes. The preceding instructions are mainly directed to highly albuminized prints ; a little modification is required for plain paper proofs ; they should be printed rather darker, as they have a greater tendency to bleach during toning, and the toning solution should be more dilute.

The prints must not be toned in broad daylight, nor in deep yellow light, for in the latter the shade of colour would not be seen. A weak shaded white light is the best. When the toning bath is new and strong, but few prints should be kept in at a time, and they must all be kept constantly turned over and moved about, so that they do not lie over each other, or get air-bubbles between them, and thus get unequally toned. In cold weather, it is better for the toning solution to be used warm ; it will then tone much quicker. A useful plan is to fill a dish with hot water and let the vessel holding the toning solution stand in it. The colour given by the gold must not only be on the surface, but must be seen when looked through as a transparency. Unless it is toned thus far, it will probably lose its rich colour in the hypo. Most prints thus lose somewhat of their tone, and allowance

for it should therefore be made, by carrying the toning a little further; but how much further is a matter for experience to determine, according to all circumstances of the moment. Some prints tone much more readily than others; some require to be carried further, according to the subject. As some are taken out, fresh untoned ones can be put in until all are toned. They can then, unless too large a batch, be all fixed at one operation. The dish of water, into which the toned prints are put to wait until they are fixed, should have some common salt put into it, the quantity not important, so that it has a distinct taste. Unless this precaution be taken, the prints will go on toning; for when they are lifted out of the bath they are saturated with toning solution. But this salt solution instantly arrests the toning action. The prints may safely be left here till all the toning is completed for the day, and are then ready for the fixing.

When a glass positive or a negative is developed, there is seen to be a portion of the yellow iodide of silver remaining that has been unacted upon by light. This is removed by "fixing." In like manner in forming a paper print there is left a portion of the chloride of silver that is unacted-on by light, and which must be removed; if it were not, the print would turn dark all over when exposed to light. This operation is called "fixing the print." There is this difference, however, between the unfixed print and the negative. In the latter you can judge by the change of colour when all the unacted-on iodide of silver is removed. But in the print the unacted-on chloride of silver is of the same colour as the whites of the paper. You cannot, therefore, judge by any change of colour when your print is fixed.

HOW TO FIX THE PRINTS.

Into your gutta-percha dish pour your fixing solution, and immerse your prints, allowing them to remain, separating and moving them about, so that the solution may get freely to them all. The prints will quickly change and lose some part of the beautiful hue they had in the gold solution, but this tint will be restored when they are finally finished.

The temperature of the fixing solution is a matter of consequence. When it is very cold, the hyposulphite materially loses its solvent action. Hyposulphite of soda in the act of dissolving deprives the water of much of its heat. Thus the solution of hyposulphite is found to be much colder than the water that was used to dissolve the crystals. It is better, therefore, in cold weather to use warm water. The feel of the solution to the hands will always be a good test for its temperature. It should always be such as to be agreeable to the hands. It need never be warmer, but it should not be used when it feels cold. The crystals should be entirely dissolved before the prints are immersed As much solution should be made as to allow the prints to be moved freely about in it. Not too many prints should be put in at once, and when they are in they should be separated from each other as quickly as possible, to allow the hyposulphite to act. If the prints are allowed to adhere to each other, and air-bubbles to form between them, no end of trouble will be experienced, and the prints will probably be spoilt. All the prints should be got in as soon as possible after each other. Ten minutes will be sufficient time to allow them to remain in. They must be kept moving about and separated from each other the whole of the time. They may then be taken out and put in a

large vessel of water, and the same process of separation repeated, so that the prints may as quickly as possible get rid of the adherent solution of hypo. When they are all separated and freely floating about, the water must be changed, and for the first half-hour the water must be renewed every few minutes, so as to remove the hypo solution which the prints are saturated with. This is the stage at which the most effectual washing can be done. The prints should be kept in running water, and, if your circumstances will permit, should be kept in for six hours, and then dried. If you cannot give them the advantage of a running stream, change the water in which they are soaked every half-hour for the first three hours; then soak them all night, and next morning give them two or three changes, and let them be dried. This well washing is a security that your prints will not fade, for more are spoilt from neglect of this important but irksome process than from any other cause.

HOW TO PRINT BY DEVELOPMENT.

Another mode of printing is occasionally adopted where light only commences the operation, and the further production of the picture is by development. There are many circumstances in which this mode is very useful, especially when the solar light is too weak to produce prints in the usual manner.

The results are not so fine as by direct sun-printing, and are best adapted for large and bold subjects.

Albuminized paper is not used, but salted paper, which you may purchase ready for use, or prepare for yourself as follows:—

Bromide of potassium ...	... 70 grains.
Chloride of ammonium ...	... 40 „
Water	... 10 ounces.

Immerse the paper—Towgood or Saxe is best—for five minutes, then hang up and dry; sensitize the smoothest side of the paper by floating the sheet on the following bath :—

Nitrate of silver	... 45 grains.
Glacial acetic acid ...	... 3 minims.
Distilled water	... 1 ounce.

When dry, expose under a negative till a very faint picture is seen, then take it into the regular dark room and place it in a very clean dish; pour over it a saturated solution of gallic acid. It will take from five to twenty minutes to develop. When the print is fully out—you must get rather a strong impression, as it loses a little in fixing—wash it well in plain water, changing two or three times, then immerse in the hyposulphite fixing bath, already named, for other prints. Allow it to remain ten minutes, then wash well, obeying all the instructions already given on the same subject. Prints produced by this formula are a very good colour, and do not need toning.

GENERAL REMARKS ABOUT PRINTING.

It is scarcely possible for you to over-estimate the value of good printing. A good print is an adequate reward for much time and labour. Good printing depends on many things; and the first step towards obtaining a fine print is to get a good negative; this secured, it is surprising how many of your troubles will be removed. The next most

important step is to get good albuminized paper. The paper used to spread the layer of albumen upon is chiefly foreign made. Paper made in this country does not suit the photographer so well as that made abroad.

Distinction between Saxe and Rive Papers.—France and Germany furnish nearly all the paper that is used, and each has its own peculiarities. Neither is a perfect paper. The principal French paper is known as *Rive*, from the place where it is made, and its peculiarities are more or less the same as those of all French papers. It may, therefore, be taken as the type. The German papers are usually described as *Saxe;* though they are made in all parts of Germany, yet the mode of manufacture is very generally the same. *Saxe paper*, therefore, represents that made by a particular method common to a large district, and is indicative of a certain character considerably different from the French or *Rive* paper.

Rive papers are much harder on their surface than *Saxe*, and the albumen sinks in less, giving, therefore, a more highly glazed face. This is very well adapted for cartes-de-visite and stereoscopics, but it is not so well suited for larger work, as the paper is apt to tear in the washing. Blisters are also more abundant; but the numerous holes and metal spots always found in this paper are its greatest objections. *Saxe* paper is much more uniform in its texture; it has scarcely any of the defects of the *Rive*, yet the albumen forms a duller surface, and the pictures seem more sunken into the paper. In practice it is much more economical to use, as there is less waste with streaks, markings, or metal spots. Some samples may be obtained with a much higher glaze than others. The tones yielded by these two

papers are rather different. The *Rive* yields warm browns and purples, the *Saxe* gives purple blacks.

HOW TO MOUNT THE PRINTS.

When dry, the prints will be very curly; but if ironed on the back with a clean, warm, flat iron, they will lie smooth, and then they may be cut and trimmed as taste dictates.

Hot thin glue may be used to mount them on cardboard; but starch, such as used for household purposes, and about the same consistency, is equally adapted. It should be used cold. To complete them, they should be sent to the hot-pressers, who, for a very small charge, will glaze them by rolling, which communicates a highly-finished appearance.

DEFECTS, FAILURES, AND REMEDIES.

"Humanum est errare."

My worthy Pupil,—In the preceding instructions I have been as clear and as simple as I could, and have avoided explanations that, in your early progress, might embarrass you. That you may be successful is my ardent wish; yet, as there is no royal road to photography, it is more than probable that you will be beset with many of the troubles common to the practice of the art.

It may be a melancholy satisfaction to know that the cleverest practitioners are subject to them in common with the less skilful; the difference, however, being, that the former, by perseverance, overcome them, while the latter give up the contest, and are beaten.

If there were no difficulties to be surmounted there

would be no credit in excellence, and one of the stimulants to advancement would be denied to the student of photography. The difficulties, however, that constantly arise, afford abundance of opportunity for the exercise of ingenuity, intelligence, and patience. It is sufficient to say, if you meet with few difficulties, deem yourself fortunate; and if you encounter many, be not discouraged, but strive to overcome them.

Generally speaking, to point out the origin of a defect is also to suggest a remedy. It is impossible to anticipate in what your difficulties will consist, for the experience of no two exactly agrees; but you must endeavour to *understand* the process, and to grasp the *spirit* of the directions. Above all things, resolve to be neat and clean in your manipulations, cool in your manner, and exercise an observing eye; by these means you will certainly escape from nine out of ten of the beginner's troubles.

Whether a person shall succeed or fail in photography depends very much on the spirit with which he commences. If he think the whole process a *mechanical* one—mainly a question of apparatus, baths, and developers—he has no pleasant future. When such a man gets into difficulty—which he soon does—he is apt to declare that his chemicals are bad, that his bath is out of order, that his camera is wrong; and he is ready to blame anything and everything, rather than his own defective manipulation, instead of calmly endeavouring to find out in what his trouble consists. Possibly he may have mixed his plain collodion and iodizing solution in reversed proportions, or strengthened his nitrate bath out of the unlabelled hypo bottle, or been trying to develop with his cyanide. Such a man soon wears himself out;

declares "it's no use trying, it's all chance;" and attributes the success of skilful men to the use of "secret dodges."

As a contrast, let us observe another kind of man, who getting into trouble, thinks it probable that it is himself that is wrong, and not the chemicals; and, instead of throwing them down the sink, perseveringly proceeds, finally discovering that the same chemicals that formerly gave him bad pictures now furnish good ones, the difference being only *in the mode of using them.* A man of this stamp, taking pride in his new acquisition, and not blind to his own deficiencies, reads the Photographic Journals, joins a Photographic Society if he can, compares notes with others who practise the art, keenly enjoys a visit to a Photographic Exhibition, and speedily becomes an intelligent and clever manipulator.

Although it is not possible to point out all the sources of failure you may experience, yet there are some that are commonly met with and easily overcome, and these will be described. When you are trying to discover a cause of failure it is important, in making changes of apparatus or chemicals, to change only one thing at a time, otherwise you will never know for certain the exact cause of your trouble. Some men never appear to care to know *why* they fail; they go on and on, always hoping for the best, and are rarely quite successful, for as soon as they are clear of one difficulty another besets them. Such a method is very unsatisfactory, and such men are not to be envied.

There is no one thing in particular that I so strongly advise, as a preventive of failures in photography, as scrupulous cleanliness. Everything used should be clean. Clean negatives can only be obtained on clean glasses. Dirt causes smears, stains, streaks, comets, and fog. It is not only

necessary to have the collodioned side of the glass clean, but also the other side, otherwise dirt is carried into the nitrate bath, and will put it out of order. Dirty dark slides cause dirty corners of negatives; dirty cameras permit dusty spots on the negative film. Dusty lenses give dim definition and require longer exposure. Dirty developing glasses cause muddy precipitates; dirty filter papers contaminate the solutions that pass through them, and dirty bottles and measure glasses spoil the materials they contain. But the worst description of dirt is dirty hands. No matter how clean or pure things are, dirty hands can spoil everything. They are constantly ready to communicate their infection. Some men's hands are always dirty from heat and perspiration, and many are so from carelessness and indolence. Dirty, sweaty hands are constant sources of photographic trouble, for they more or less contaminate everything they come in contact with.

Dirt is happily described as "matter in the wrong place;" dirt must, therefore, be hostile to successful photography, which consists in having matter in the right place. For practical purposes I may describe dirt as mechanical and chemical; mechanical dirt is that which adheres to the surface of objects from atmospheric action, or from imperfect washing, or dirty water. Chemical dirt consists in the remains left on glass, in bottles, and in measure glasses, of former materials employed, and which decompose and alter the nature of the fresh materials used afterwards.

Inferior photographers, as a rule, are dirty and slovenly in all their manipulations and arrangements; some good operators are dirty and careless, but their success arises from their general ability, to which their slovenliness is a decided draw-

back. Most successful photographers are, however, in all essential particulars, scrupulously clean.

I dwell on this value of cleanliness because I know by attention to it you will avoid so many causes of failure. Besides, what is the use of my giving advice how to extricate yourself from your troubles if you carry at your finger ends the constant means of creating new ones?

The general instructions previously given have, in the main, been on the assumption that all your manipulations were successfully accomplished; experience teaches, however, that failure may meet us at every turn. To complete our task then we must devote attention to these failures —to photography under difficulties, photography out of sorts, photography ill, sick, knocked up, and confined to the hospital. Like a skilful physician, I must describe the various ailments and the means of effecting a cure. I shall first speak of the

DEFECTS COMMON TO GLASS POSITIVES AND NEGATIVES.

THERE is no trouble more common, and which may arise from so many different causes, than that known technically as "*Fogging*," *that is, a darkening of the film all over, directly the developing solution is applied.* This defect has several sources. It may exist in a small degree, only slightly obscuring the shadows of the picture, or it may be to so great an extent as to prevent the appearance of the image. Fogging often troubles the young beginner, and as it arises from many causes, it is often difficult to assign it to the right one. Sometimes deleterious vapours are the reason; as—the dark room being built over a stable, and filled with reeking

vapour; the room being newly-painted with a slow-drying paint; a leakage of gas; a bottle of ammonia with a badly fitting cork or stopper. A remedy for any of the above is simply to remove the cause.

In extremely warm weather the developing solution is much more energetic, and fogging may thus arise from this increased energy: remedy, dilute the developer with water one-half or double the quantity of acid. The following are, however, the most usual causes of fogging:—

Alkalinity of nitrate bath: remedy, addition of acetic acid till litmus paper is *slightly* reddened.

Extreme acidity of nitrate bath: remedy, addition of oxide of silver or ammonia until litmus paper is only slightly reddened.

Omission of acetic acid in the developer, or not sufficient acid introduced: remedy, add the acid, or increase the quantity.

Over-exposure in the camera: remedy, give shorter exposure, or insert a smaller sized diaphragm in the lens.

Diffused light in the dark room. If yellow calico be used, it has perhaps become bleached, and must be replenished; or additional folds must be used. Sometimes chinks of unsuspected white light are the cause; if so, they must be stopped up.

Diffused light in the camera or the dark slide, admitted through a joint giving way, or an old screw-hole, or the parts of the camera not fitting: remedy obvious.

Nitrate bath made with impure silver, or bad water: remedy, add a few drops of saturated solution of bicarbonate of soda until the bath solution remains turbid after shaking; then expose it to the sun for a few hours, and filter; acidify it if found necessary.

Newly-mixed collodion will sometimes cause fogging; it then requires to be kept for a few days, when it may work clean; or it may be mixed with some older collodion, and may then be all right. Collodion should always have a golden sherry-colour in order to work without fog. When it is nearly or quite colourless, this golden colour can be communicated by the addition of an old sample that is of a deep brown colour; or if no such old collodion be at hand, a few drops of tincture of iodine may be added till the collodion acquires the colour; or a grain or so of iodine may be added direct to the collodion, in which it will rapidly dissolve. If none of these aids are sufficient, then the collodion must be rejected.

When you make any change—such as having a new camera, a fresh nitrate of silver bath solution, a new quantity of developer, or another sample of collodion—you may be able at once to suspect, and perhaps detect, the cause of fog; for if some change occurs in the nature of the pictures which did not exist before, it is very probable that this fresh circumstance is directly connected with the changed character of the pictures. Therefore, whatever it is that has been newly introduced should be carefully examined, and very probably the cause of the fogging may be discovered. When, however, you have no such clue, you must adopt a systematic method for its discovery. The following is a certain means of finding out the cause:—

First, examine your dark room, by covering your yellow window with some material that entirely excludes *all light.* Crevices and cracks admitting white light may then be seen that before were unnoticed, and some of them may have shone on the glass during its preparation, and caused fog.

If such be found, they must be stopped up, and your annoyance will be over.

If these be not the cause, next suspect the window, for though it may admit only yellow light, it may not be yellow enough. Yellow materials become bleached, and require renewing, especially yellow calico. To test your window—and it is very important that you be quite certain on this point—proceed as follows: collodionize a plate as usual, and immerse it in the bath; then cover up your yellow window entirely, or leave only the smallest possible chink, so that you can just see what to do. Take your plate out of the bath, and put it in the dark slide. Now remove the covering from the yellow window, and draw up the shutter of the dark slide *half way*, to expose *one half of the plate;* keep the plate to the light of the window for, say, five minutes, then replace the shutter, close up the window as before, so as to exclude the yellow light, and proceed to develop your plate. Keep the developing solution on about the usual time that is required to produce a picture, for you will not be able to see what is going on; then wash and fix it. Now restore the light and examine the plate, and it must present one of the three following appearances:—Case A, the half exposed to the window is drab, and the half not exposed is quite clear and transparent; Case B, it has a drab deposit—in other words, fog—all over it; Case C, the plate is perfectly clear and transparent all over.

We shall examine each of these cases in succession. Case A shows that the yellow window is at fault, for half the plate exposed to it is fogged, but the other half is clear; therefore sufficient chemical light passes through the window to injure the plate. The yellow covering, if bleached, must be

removed, or more coverings must be supplied, and a plate must be tried after each addition, until you have your window so yellow that a plate may be exposed five minutes without being fogged. Yellow glass sometimes allows light enough to pass through to fog the plate; such glass should be removed and a better sample put in its place. I have seen a piece of yellow-brownish glass, though very dark in colour, that admitted actinic light almost as freely as white glass. This is rare, but in photography you try all things, and only hold fast to that which is good. If the window be discovered to be the cause of your trouble, it must be covered with fresh calico, tammy, silk, paper, glass, or other yellow material; or it may be painted yellow; but in some manner the light must pass through a yellow screen in such a way that, while you are permitted to see your manipulations, your plate must remain without fog. You must have no rest till this is accomplished. This done, your fogging trouble is over, and you may proceed to work in comfort; for Case A clearly showed the window was the cause of the fog.

It should be borne in mind, however, that the amount of protection that a yellow window gives to sensitive plates depends upon the quantity of light that falls upon the window. Plates may be fogged on a day of sunshine, and yet be perfect on a dull day. A yellow window with a western aspect may suit a morning light, and yet cause fog in the afternoon. When the window of the developing room is thus exposed to a variable light, it should be provided with an additional moveable yellow curtain, to be used when a stronger light than usual falls on the window.

If the cause of fogging has thus been satisfactorily traced and cured, it will form an excellent lesson. But as there are

other causes of fogging than an imperfect yellow window, let us examine the plate as shown in Case B.

Case B, the plate darkens all over under the action of the developer, and you can distinguish no difference between the two halves: this shows that your window is quite right, and you must seek further for the cause. It must now lie between the bath, the collodion, and the developer. First, try the bath; test it with a strip of reddened litmus paper, and if it changes to blue the bath is alkaline, and an alkaline bath is a common cause of fogging. Add acetic acid, drop by drop, testing between each addition, until blue litmus paper is *very* slightly reddened. Again try a plate; the fogging will probably not be quite gone, but much reduced: add a little more acid until it entirely disappears.

Suppose, however, that the reddened litmus paper did not change colour, then test with blue litmus, and if it turn *very* red, carefully neutralize with oxide of silver, or ammonia, until only a slight acidity remains; then resume your trial to see if you have expelled your enemy, for excess of acid, especially nitric, will cause fog. Should the test-papers show that the bath is neither very acid nor alkaline, the probability is that the error is in the developer or the collodion.

Make up, carefully, a fresh developing solution, being particular not to omit the full proportion of acetic acid. You may even increase the quantity of acid, for some samples are weak, and you may happen to have one: the developing solution, unless it have its proper addition of acid, will always cause fog. If the new developing solution rid you of your difficulty, that will show that the cause of fog was in the developer; if, however, the fogging still remains, you must

suspect your collodion. Some collodions cause fog, therefore get some fresh, and let it have a little colour—a pale golden, for instance—for colourless collodions are more prone to fog than coloured ones. If you are not now relieved, you may assume that the nitrate bath is the defaulter, for it must be one of the three. Make up a new bath, and if you use good silver and clean water, you are almost certain to be out of your trouble.

In this way, by carefully and exhaustively examining one thing at a time, you will be certain to trace out the delinquent material. If you have decided that the nitrate bath, for instance, is the cause, then, if it be a new one, you have to find out whether the sample of nitrate of silver is pure, or whether the water is the cause. The latter is frequently an unsuspected source of trouble. Again, if it be found that the developer is at fault, supposing it to be correctly mixed, each of its components may be suspected and examined in turn—the iron, the water, the acetic acid, and the alcohol. Some samples of methylated alcohol often cause great annoyance by impurity.

To return to our examination: supposing that we have not yet discovered the cause of our fog; the conditions of Cases A or B not applying, let us examine Case C.

In Case C, the plate develops perfectly clean and transparent all over: this shows not only that the yellow window is all right, but that the chemicals are right also; in fact, that the origin of the fog must be external to the dark room; and, as nothing else but diffused light can now be the cause, we must seek to discover it. First, examine the dark slide well; in some unsuspected manner it may admit light to the plate.

If your dark slide be found to be perfect, next examine your camera carefully. You may test it in this manner: prepare a sensitive plate as usual, and place it in the camera as if you were going to take a picture; put the cap on the lens, draw up *half way only* the shutter of the dark slide, but do not uncover the lens. Let the plate remain thus for a full minute, then develop and fix the plate. The plate will either be one-half fogged, or it will be quite clear all over. If half be fogged, it shows that the camera admits light in some other manner than through the lens, and thus the fog is caused. To know where the light is admitted, remove the ground-glass; and, excluding all light with the focussing cloth, put your head into the camera (the lens being still covered), and you will see the light streaming in. You may examine the interior of your camera in another manner. Place the dark slide in its place, and draw up the shutter; remove the lens, and with the aid of the focussing cloth again examine the interior through the flange aperture. If any stray light be admitted, you will see it reflected from the face of the plate. It is necessary, when thus examining the interior of a camera, to wait for a few minutes, to allow the eye to get accustomed to the darkness, or you may deceive yourself, and think there is no light, from your momentary inability to perceive it. Supposing that you have found the light streaming through cracks, crevices, or holes, they must be stopped up; and the cause of your fog being discovered and removed, your trouble is over.

Should your plate, however, develop clear all over, it will show that the interior of the camera is perfect. Another cause of fog may arise from the lens itself. If a strong light fall on it, particularly sunshine, fog will certainly be pro-

duced. A screen or shade should be provided, so that no light fall on the lens, except from the objects that are being delineated. Occasionally there is reflection from the sides of the lens tube, or the edges of the back lens. Dead-black varnish will be the remedy in these cases.

If you have not now traced out the difficulty, having run through your chemicals and apparatus, it most probably is caused by an error of manipulation, such as over-exposure, or a deviation from the proper mode of developing. It is scarcely probable, however, that you could pursue this inquiry without already having a clue to the real cause. I have gone through this series of exhaustive experiments to show you that by this method of inquiry, you may succeed in tracing not only fog, but almost any other trouble to its true source.

Transparent spots.—Causes: particles suspended in the collodion; allow the collodion to settle and do not use it to the bottom of the bottle. An ingenious Collodion Filter is sold at the shops for filtering collodion from insoluble particles. Transparent spots may also be caused by particles floating in the nitrate bath and adhering to the surface of the film while the plate is being sensitized; remedy, filter the bath. These spots may also be caused by the dark slide falling, or receiving a knock while the plate is in it, and particles of dirt falling from the interior of the dark slide on the film. Extremely firm transparent spots in enormous quantities, technically known as "pin holes," are caused by the nitrate bath becoming overcharged with iodide of silver; remedy, dilute the bath with an equal bulk of distilled water which will cause a dense precipitate of iodide of silver, filter and add sufficient nitrate of silver crystals to restore the bath

to its proper strength. It is better to add the bath solution slowly to the distilled water than to add the water to the bath solution, as a denser precipitate of the iodide of silver is thus produced.

Opaque spots.—Causes : developer not filtered ; dust falling on the plate while being coated ; dirt, and dried fragments of collodion from lip of collodion bottle ; dust and dirt from dark slide.

Streaky lines in the direction of the dip.—These are often caused, in a new bath, by a deficiency of acid ; in an old one, by the accumulation of ether and alcohol. Remedy : in the first case, add acid cautiously till the streaks disappear ; in the second, mix with it an equal bulk of fresh 35-grain solution of nitrate of silver, or, better still, make up a new bath.

There is, however, another remedy for these streaks, which is very simple ; it is to gently agitate the plate directly it is placed in the bath, and to keep it moving for twenty or thirty seconds afterwards.

Sharp horizontal lines across the plate.—These are caused by hesitation in dipping the plate into the bath.

Collodion film mottled and thick.—The collodion requires diluting with a little plain ether.

The collodion film, on drying, peels off the glass.—This is often due to inferior collodion ; but the most usual cause is dirty glasses. It will arise also from pushing the development too much in cases of under-exposure. Also from intensifying weak images by bichloride of mercury or other intensifiers.

The collodion film is full of honeycomb-like markings ; the film has transparent, crapy, diagonal lines, especially where the deposit is greatest.—These defects all arise from inferior collodion ; procure some of better quality.

Opaque white marks and streaks at the end of the plate where the collodion was poured off.—Keep the plate a longer time before you immerse it in the bath; if this does not prevent the markings, add a little plain *un-iodized* collodion.

Transparent insensitive mark at the opposite end to where the collodion was poured off.—The plate was kept too long out of the bath, and the upper part has become dry; the plate must be immersed sooner into the bath.

Markings like curtains and fringes.—When these do not occur from bad manipulation—and be careful not too hastily to decide—these faults may arise from the collodion or the bath, and the best remedy is to endeavour to obtain samples that will work without thus plaguing you. When a strong iron developer is used, it is important that you have the proper quantity of alcohol in it, as this causes the solution to flow easily and smoothly all over the plate, and allows the developing solution readily to combine with the silver solution which is on the film. When the developer flows in irregular greasy lines, there are sure to be abundance of stains from this cause alone.

DEFECTS IN GLASS POSITIVES.

The light parts are pale and misty, and what should be the dark parts are drab-coloured.—Over-exposure produces this effect; reduce the time in the camera, or place a smaller diaphragm in the lens, to cause it to work slower. If this treatment does not remove the mistiness, it may be produced by some of the causes of "fog," the remedies for which have been previously stated.

The blacks are very deep and brilliant, but deficient of detail, and the lights rather dark.—The exposure in camera

has not been sufficient, or the developing solution has been poured off too soon.

The picture, after washing off the cyanide solution, has blue stains.—The developing solution has not been sufficiently washed away before the fixing solution was used.

The shadows of the picture are clear, but the light parts are chalky, and deficient in half-tone.—The developing solution has been kept on too long.

The picture is brilliant when wet, but on drying becomes dull, the shadows being misty blue instead of bright black.—Bad collodion is the cause of this defect.

DEFECTS IN NEGATIVES.

The picture very intense where the light has acted most, and nearly transparent in the shadows.—The plate is under-exposed and over-developed.

The shadows have nearly as dense a deposit as the high lights.—The plate is over-exposed.

The image will not intensify under the action of the pyro-gallic acid and silver solution.—There are many causes for this defect, and you must discriminate which is the most probable in your own case, and act accordingly. Bad collodion—inferior nitrate of silver—too much acid, especially nitric, in your nitrate bath—the exposure, too long or too short, in the camera—the absence of sufficient nitrate-of-silver solution on the film or in the developing solution—cold and dark weather—deficiency of light—too small a stop used with long focus lens.

The film floats off, or breaks away from the glass, during development or subsequent washing.—Defect in the collodion, or carelessness in manipulation; too much acid in the

nitrate bath; plate immersed in bath too soon, or kept out too long; the edges of glass not sufficiently roughened.

The formation of crystals under the film when dry.—The hyposulphite solution not washed away enough. Sometimes this will show immediately; at other times it may be days or weeks before being seen.

Irregular smears and stains.—Dirty glasses are the most usual cause; also lifting the plate out of the nitrate bath too soon; placing it in the dark slide before the greasy lines have disappeared; not draining sufficiently, and the solution accumulating at the bottom; from dirty and wet plate-holders in the dark slide; handling the plate with dirty hands; the developing solution not flowing uniformly; pouring the developer principally on one spot; plate immersed in bath too soon, or not soon enough; developing glass not clean.

DEFECTS IN PAPER PRINTS.

The paper does not print equally all over; has marbled or mottled spots.—The silver solution is too weak, or the paper has not been floated a sufficient time.

The print when finished has a disagreeable yellow tint, and on looking through, yellowish-brown opaque patches are seen.—The print is not fixed; the hyposulphite is too weak, or has been in use too long, or the print has not been immersed long enough to dissolve the chloride of silver.

The whites and blacks are very brilliant, but a deficiency of detail in both.—The negative is at fault, under-exposed.

The prints are weak, cold, and slaty.—Under-printing and over-toning are the general causes. The hyposulphite solution may be too strong. Over-exposed negatives produce weak prints, deficient in proper contrast.

The prints are grey and mealy.—Over-toning and defective paper, or general faulty manipulation.

Red spots, streaks, and markings.—Defects in the paper, or the albuminizing, or both.

Prints will not readily tone, but remain of a brown, leathery hue.—Toning bath too alkaline; chloride of gold deficient in strength; the toning-bath exhausted; the paper kept too long before being printed on, or, after being printed, kept too long before toning.

Metallic smears, spots, stains, finger-marks, &c.—These defects nearly always arise from bad manipulation; handling the paper with dirty fingers; allowing solutions to splash; putting the paper on a dirty table; dust and dirt in the printing-frame, or on the pads used in the latter, or similar causes; or they may occur from bad paper.

GENERAL RECOMMENDATIONS TO THE PUPIL.

THE proposed course of instruction in the collodion process is now completed, practice is only required to make you perfect, and to render the practice of the art a source of pleasure or profit.

From the progress you may be presumed to have made, there will be no need to continue the homely and familiar style in which the instruction has been hitherto conveyed, and the remainder of the information will be given in a more condensed form.

In Part II., you will find directions for the preparation of sensitive dry plates. These you should not attempt until you are quite competent to use wet plates, as they are subject to most of the failures of the wet process, together with difficulties peculiar to themselves.

Part III. contains much information that will be more useful to you as you acquire increased experience, and is more addressed to the expert photographer than to the mere learner.

Your attention is invited, however, to the following hints and general advice, by attention to which you will save much valuable time and materials, and render the practice of the Art more interesting and profitable :—

Concentrate your attention on the production of a good clean negative ; a professional printer may be employed to produce your prints.

Never expect the faults of your negative to be corrected in the printing ; a good print can never be produced from a bad negative.

Take pride in cleaning the glasses well ; stains and smears always indicate slovenliness and inattention.

Whenever you take a negative, take as good a one as you possibly can, even though it be a bad subject ; almost anything looks well in a first-rate photograph ; moreover it is excellent practice.

Never be contented with a medium quality of picture if you can obtain a better one ; "I dare say it will do!" will not do at all in good photography.

Obtain the most perfect apparatus that your means afford, and take pride in keeping them clean and in good order.

Before using your lenses wipe them with a soft chamois leather, and dust out the interior of your camera with a damp cloth.

Wipe your dark slide dry after each plate ; the accumulation of nitrate of silver at the bottom corners of the dark

slide stains the plate, rots the wood, and denotes the careless operator.

Frequently re-varnish the interior of your dark slide where the sensitive plate rests.

Carry your dark slide in a cloth when taking it from place to place (especially out of doors), and cover the top of the slide with it while the plate is being exposed.

Keep your camera exactly level when perpendicular objects are to be represented.

Get all parts of the picture into focus if you can; if you cannot, then make the principal objects the sharpest—in a portrait, the eye; in a group, the central figures; in a landscape, the foreground, in preference to distant objects.

Keep your nitrate bath always covered, and your bottles well corked and stoppered, as well as distinctly labelled.

Wash your hands after taking one picture, before commencing another.

Wash your developing-glass after each time of using.

Keep a separate vessel for every solution, and a separate bottle and funnel for each distinct purpose. Much time and trouble in cleaning dishes and bottles will be saved, and no end of uncertainty removed.

Never open a bottle of collodion, ether, alcohol, or varnish near a flame, or an explosion may take place.

Never allow the sun to shine on the lens when taking a picture.

Never attempt landscapes on windy or misty days.

Of the two errors, under-exposure is worse than over-exposure.

Aim at good pictures rather than quick ones.

There is more certainty in working a slow than a quick process.

Learn one process thoroughly, so as to be able to depend on it; then, and not till then, amuse and instruct yourself by practising others.

Do not attempt any dry-plate process until you are thoroughly master of the wet-plate process.

Use plenty of water everywhere; hypo left in your negatives will cause them to crack; hypo left in your prints will cause them to fade.

Wash your plates well; wash your negatives well; wash your prints well; and wash yourself well.

Ventilation is the soul of health. Ventilate your dark room; ventilate your bath, your camera, your tent, and your ideas.

Read, mark, learn, and inwardly digest the experience of others as exhibited in the Photographic Journals.

Don't be led away by every fresh idea you hear; don't expect to succeed with every new process you read of, but don't condemn it because it fails in your hands.

Don't believe every novelty to be an improvement; don't hastily credit every new discovery; make great allowance for the exaggeration and enthusiasm of inventors, but keep your mind open and unprejudiced to receive every new truth, from whatever quarter it may proceed, or in whatever guise it may appear.

PART II.

GENERAL REMARKS ON THE VARIOUS DRY PROCESSES.

The instruction previously given refers to the use of the collodion plate in its wet state. Under many circumstances, however, it is inconvenient, or even impossible, to work the process, in consequence of the necessary attendant apparatus. Yet the desirability of obtaining photographs remains the same. Various means have been devised to use the plates *dry*, so that, being prepared before starting, they may be exposed during a journey away from home, and developed and finished on the return. This method of using sensitive plates naturally increases the usefulness of photography, but the knowledge how to prepare a wet plate is not alone sufficient to prepare a dry one. If the usual wet sensitive plate be allowed to dry, without taking any precautions, it will be found to be quite incapable of taking a photographic picture. It has to pass through another process, more or less complex, to enable it to be so used. It will be unnecessary here to detail all the methods that have been devised to so prepare the plate. It will be sufficient to describe a few of the most perfect plans.

Essentially, all the dry-plate processes are the same: they start by coating a plate with collodion, and sensitizing it in a nitrate of silver bath; their differences consist in the various methods employed to preserve the sensitiveness that

the plate has attained. In most, if not in all, this sensitiveness is materially impaired; but, as the subject becomes better understood, it will probably be found that the plate in its dried state is as susceptible to the influence of light as it is when wet.

A sensitive dry plate is often treated as a wet plate *minus the water*, and by restoring the water the plate has been expected to return to the condition of an ordinary wet plate. Experience, however, has not quite confirmed this reasonable supposition. A re-wetted sensitive plate, even when re-immersed in the nitrate bath, does not return to the condition of an undried plate, and the mode of development so exactly adapted to the wet plate is not so well suited to the dry one when re-wetted. Let the idea be once recognised that the dry plate is not bound necessarily by the conditions of the wet, and the path of discovery is opened. Great success has already been obtained by working in this direction, and that future advances will be made is extremely probable.

ON PREPARING DRY COLLODION PLATES.

The preparation of the wet plate being already so fully described, it will only be necessary briefly to say that all the preliminary manipulations, unless where described otherwise, are exactly the same. The point of divergence commences when the plate has been fully sensitized in the nitrate bath. Instead of putting it in the dark slide and immediately exposing in the camera, the plate is submitted to sundry operations, and then allowed to dry. These operations distinguish the various "dry processes."

The collodion film, as already remarked, when once dried, changes its character; and when re-wetted, never returns to the previous porous, pappy condition. It becomes skinny and horny, and does not adhere well to the glass. In some processes a thin coating of albumen is first put upon the plate, to prevent the film slipping off when re-wetted, and during development.

Another plan is to varnish the sensitive film a quarter of an inch all round before re-wetting the plate.

An excellent suggestion by Mr. Bartholomew is, to pour dilute alcohol over the plate prior to developing; this seems to restore, to some extent, the porous condition. When the alcohol has well soaked in, the plate has to be washed, and the developer applied as usual; all the subsequent operations will be made better through this preliminary wash of alcohol, the plate behaving more like an ordinary wet one, and the film adhering better to the glass.

It will be seen, in glancing over different processes, that though the final end, a sensitive dry plate, is the thing aimed at in all, the means adopted to secure it are very varied. In nearly every case a something is incorporated with the sensitive film which is not present, or even needed, when the plate is used wet. The employment of the simply washed and then dried plate is, though the easiest, perhaps the least certain of all: yet some persons use the process with success. Nearly all experimenters find that by adding a final wash of some substance, the image develops and intensifies more like a wet plate than without this addition. The number of these preservative substances is endless, and the mode of employment constitutes the different dry processes. No end of aqueous solutions of animal and vegetable substances have been used

with different degrees of success. Albumen is deservedly a great favourite. Gelatine has been applied in more than one form, and sugar in many—to wit, honey, treacle, grape sugar, brown and white sugar, candy, and caramel; many syrups, especially raspberry; different gums; solutions of malt, beer, and ale; various wines, British and foreign; liquors and spirits; milk, tea, coffee, starch, dextrine, and kindred substances; in fact, there scarcely seems a limit to materials capable of being used for the purpose, so that the question is quickly obtruded, which is the best? To this there is no definite answer, for good pictures have been taken by every process. For absolute certainty, the Collodio-albumen, in its primitive form, is recommended; and for simplicity, the "Washed-plate."

HOW TO DEVELOP DRY PLATES.

THERE is usually only one way to develop a wet plate; there are several ways of developing a dry one. Instead of repeating any or all of these, in detailing the dry processes, it will be better to give them fully in detail once, and refer to them afterwards.

Iron is not often used as a developer with dry plates; pyrogallic acid seems much superior. It may be used plain, or with an acid added to it, or with the addition of an alkali.

Plain Pyro Developer.—When pyro is used, without any addition, its strength may vary from one to five grains to the ounce of water; two grains may be taken as a medium. The dry plate being flooded with water so as to well wet the film, the pyro solution is floated over, and in a few minutes—but not so quickly as a wet plate—the image appears. The image

produced is a very weak and thin one. When all the details are fully out, then a few drops of an acid silver solution may be added to it.

ACID SILVER SOLUTION.

Nitrate of silver	15 grains
Citric acid	10 grains
Water	1 ounce.

The addition of the acid silver communicates intensifying power, and the image quickly acquires density according to the quantity of silver added.

Alkaline Pyro Developer.—It is advisable to make up three stock solutions—

No. 1.	Pyrogallic acid	96 grains
	Absolute alcohol	1 ounce
No. 2.	Carbonate of ammonia ...	96 grains
	Water	1 ounce
No. 3.	Bromide of potassium ...	10 grains
	Water	1 ounce

At the time of using make up the following solution—

Water	1 ounce
Solution No. 1	10 minims
Solution No. 3	5 „

Pour this over the wetted plate ; allow it to remain on a few seconds only, and then pour back into the developing cup and add to it 5 minims of solution No. 2, and apply again. The development will now commence, and if it be necessary, 5 minims more of No. 2 may be added, if the details indicate under-exposure. In this developing process the chief agent of course is the pyrogallic, and its power is materially stimulated by the alkaline carbonate. When these

two are used alone there is a tendency to produce fog before the development is complete. The addition of the bromide corrects this. The bromide requires caution in its use, as its effect is not only to check reduction and retard development, but, if used too freely, to prevent development altogether. Therefore as little of it should be used as possible. The exact quantity must be determined by the judgment of the worker. So that there be enough present to prevent fog, that is sufficient, no matter how little that may be. It may in some cases be omitted altogether. If the quantity named be not sufficient to arrest fog, more must be added, the behaviour of the plate during development being, after all, the best test. The details being well out, pour off the developer, wash the plate and intensify with the acid pyro and silver solution.

Acid Pyro Developer.—This developer may now be considered as an old-fashioned one, as it is being supplanted by those already given. When it is employed the exposure must be considerably prolonged. It is formed as follows—

Pyrogallic acid ...	... 1 grain.
Glacial acetic acid	... 30 minims.
Water	... 1 ounce.

The plate after being wetted has this solution flowed over it, to which has been added two or three drops of a 10-grain nitrate of silver solution. Care should be taken not to add too much silver until all the details are out; more may then be added to produce sufficient intensity.

In all instances, whatever developer be used, the plates must be fixed as usual. Hyposulphite of soda is better than cyanide to use for all dry plates. It will frequently be found

advisable to postpone a little of the intensifying until after the plate is fixed, as the colour is more non-actinic than the usual wet plates, and this peculiarity of colour cannot be so well discerned prior to fixing.

THE SIMPLY "WASHED-PLATE" PROCESS.

This is the simplest process of all, and consists in preparing and sensitizing the plate as for the wet method, then washing it well in distilled water, to get rid of all the superficial nitrate of silver solution. The plate is then to be carefully dried in the dark. The exposure should not be much more than for a wet plate. Prior to development the plate must have the edges varnished and be re-immersed in the nitrate bath, and the development conducted just the same as for a wet plate, the ordinary developing solution being used. These plates will not keep. They should be prepared over-night, and used the next day, and developed as soon as possible after exposure.

With favourable samples of collodion this process yields good pictures.

MR. RUSSELL MANNERS GORDON'S GUM AND GALLIC ACID PROCESS.

Any good collodion may be used, but the chief commercial ones may be improved by the addition of two grains per ounce of bromide of cadmium. The nitrate bath should be as nearly neutral as possible. It should not be of less strength than 40 grains per ounce. Allow the plate coated with collodion to remain from ten minutes to a quarter of an hour in the bath, so as to sensitize thoroughly; wash by immersing in distilled water in two successive dipping

baths, then under the tap, and finish with distilled water; next flood the plate, still wet, with the following preservative solution.

I.	Picked gum arabic	20 grains.
	Sugar candy	5 grains.
	Distilled water	1 ounce.
II.	Gallic acid	3 grains.
	Hot water	1 ounce.

These two solutions should be dissolved separately, and mixed in equal proportions, and filtered at the time of using. The first portion of the solution should be allowed to freely flow off, carrying with it the water on the film. A second portion should be allowed to soak into the film for about a minute, and then be turned off, and the plate put away to drain and dry in a perfectly dark place. The plates will require to be edged with india-rubber solution, or dilute albumen, or varnish, before development. The exposure in summer time with good light will be about twice or three times that of wet plates, but in winter, or a dull light, the exposure will be proportionally longer. The *backs* of the plates should be painted with some yellow, green, or red colour to prevent the light passing through and causing "blurring." This paint must be carefully removed after exposure and before developing. These plates will keep for a considerable time before exposure, but Mr. Gordon considers it a golden rule in this, as in all dry processes, to develop as soon after exposure as it is convenient.

For development the alkaline pyro is recommended, which see; or even better, the gelatino-iron developer (see page 106), to which a few drops of nitrate of silver solution should be added at the time of using.

THE COLLODIO-ALBUMEN PROCESS.

This process is not only one of the oldest, but also one of the safest and most reliable of the dry processes. It is sometimes called the "Taupenot" process, in compliment to the inventor. It is in reality a double process, in which sensitized collodion and albumen each play an important part in the production of the negative, and by its means Mr. Mudd of Manchester, and others, have produced some of the most lovely photographs that have ever been taken.

The collodion employed is the ordinary bromo-iodized; it should be of the kind that adheres tenaciously to the glass. Pour it on as usual, and let it set well before immersing in the nitrate bath. A pneumatic holder should be used, so that the plate may be covered at all the corners. Next immerse it in the following

NITRATE OF SILVER SOLUTION.

Re-crystallized nitrate of silver	1 ounce.
Distilled or boiled rain-water	12 ounces.
Glacial acetic acid	½ ounce.
Iodide of potassium	2 grains.

Dissolve, filter, and the bath is ready for use.

When the plate is sensitized, wash it well first with distilled then with common water, and place it in a dish half filled with solution of iodide of potassium, three grains to the ounce, and allow it to remain while the next plate is being prepared. Then remove it from this solution, and wash it well with

clean water, and pour over its surface the following solution of iodized albumen :—

Distilled water	$2\frac{1}{2}$	ounces.
White of eggs	10	„
Iodide of potassium	50	grains.
Bromide of ammonium ...	10	„
Liquor ammoniæ (fortis) ...	120	minims.

Place these materials, together with some pieces of broken glass, in a bottle capable of holding twice the quantity, and agitate till the whole forms a froth, and then, when settled, it is ready. Any other method of beating up the albumen will do, and this one is mentioned as being simple and effective. This solution will keep a considerable time, but must be filtered before using.

Allow the solution to flow backwards and forwards, to well saturate the film ; repeat this operation with a second portion, and then set the plate aside to drain on blotting-paper. When the moisture is principally removed, finish the drying before a fire, or by other convenient means.

The plate, in this condition, is nearly insensitive to light, and provided it be kept dry will remain good for any time.

To render it sensitive, heat it as hot as the hand will bear, and, when cool, immerse it again in the following aceto-nitrate of silver bath for one minute, *using only a yellow light*, then wash thoroughly in clean water, and dry in the dark.

ACETO-NITRATE BATH.

Nitrate of silver	30	grains.
Distilled water	1	ounce.
Glacial acetic acid	$\frac{1}{2}$	drachm.

When this bath becomes discoloured—which it will by sensitizing the albuminized plates—it should be poured into a bottle containing a couple of ounces of kaolin, and when well shaken allowed to rest for some hours. This will remove the colour. The kaolin may be kept in the bottle for future use.

These sensitive plates will keep good for a few weeks in warm weather, or even months in cold, if the last washing has been perfect; yet it is better to use them as soon as convenient after their second sensitizing. They will require about six times as long exposure as ordinary wet collodion, but a little over or under is not very important; an error on the former side being better than the latter, the special point being to expose sufficiently long to bring out all the detail in the deepest shadows.

The development may be by either plain or alkaline pyro; Mr. Mudd gives the preference to plain pyro and intensifying after with acid silver.

For most interesting and lucid instruction in this process the reader is refereed to Mr. Mudd's valuable *brochure*, entitled "Collodio-Albumen Process, and other Papers." This book gives the fullest information on the process, and contains Mr. M.'s narration of his own *modus operandi* in the production of those charming pictures which have made his name so famous.

DR. RYLEY'S MODIFIED COLLODIO-ALBUMEN PROCESS.

The plate has to be sensitized as usual, and thoroughly well washed. Coat the plate with the following solution of albumen :—

Albumen	1 ounce.
Water	2 ounces.
Ammonia	30 minims.

Beat well up to a froth, allow it to settle, and filter before use. Pour sufficient of this over the plate to cover it ; let it flow backwards and forwards to soak into the film. Pour the albuminous solution away, and thoroughly wash the plate, the last rinsing being with distilled water. Let the plate dry. When perfectly dry, moisten the plate with distilled water, and pour over the following solution :—

Gallic acid	2 grains.
Water	1 ounce.

Filter the solution before using. Pour it on and off the plate to well permeate the film, then set the plate up to drain, and dry without washing off the gallic acid solution. When surface-dry, finish by the heat of a dull fire.

These plates retain their sensitiveness well. Mr. Morley of Islington once showed me a negative that had been sensitized six months before exposure, and it was as perfect as plates newly prepared. The development of the plates may be by the plain or alkaline pyro method.

The peculiarity of this process consists in the final wash of gallic acid *after the prepared plate has dried from its albuminous coating.*

An interesting experiment was tried by Mr. Morley to test the utility of this final wash of gallic acid. On one occasion, having some plates prepared without the gallic acid, but which, on examination prior to exposure, looked very unsatisfactory, having stains and markings of an annoying character very plainly evident, he determined to test the usefulness of the gallic acid. Upon a particular plate he poured, but on one half only, a solution of gallic acid. The plate was dried, exposed, and developed as usual, and on the half without gallic acid the image was poor, weak, and dirty; while the other side was brilliant, clean, stainless, and all that was to be desired.

MR. ENGLAND'S MODIFIED COLLODIO-ALBUMEN PROCESS.

THE plate having been coated with bromo-iodized collodion, and sensitized as usual in a forty-grain bath, should be washed till all greasy lines are removed; next float over the film an albuminous solution formed of one white of egg to three ounces of water and two drops of ammonia. These require to be well beaten together and filtered. When this solution has been poured over the film backwards and forwards to well permeate it, the plate has to be washed again under a gentle stream, ending with a little distilled water. The plate has now to be re-sensitized by flowing off and on a thirty grain solution of nitrate of silver, slightly acidulated with acetic acid. Again wash well and dry. This latter sensitizing gives increased vigour and sensitiveness to the plate. The exposure should be about three times longer than for a wet plate. Either "plain pyro" or "alkaline pyro" may be used to develop, and intensify with acid silver and pyro.

COLLODIO-BROMIDE PROCESS.

This process was introduced by Messrs. Sayce and Bolton. Its peculiarity mainly consists in the dispensing with the nitrate bath and using a collodion which contains the sensitive salt. The greatest care is required in preparing the collodion. It is composed as follows :—

Pyroxyline	6 grains.
Ether	½ ounce.
Alcohol	½ „
Bromide of cadmium	6 grains.
Bromide of ammonium	2 „

Mix as much of this as may be required, as it will keep indefinitely. It should stand a week before being employed.

When the above is ready for use, pound nitrate of silver to the finest possible powder in a glass mortar, and add eleven grains to every ounce of the above bromized collodion. Add it gradually, and shake it so as to get it well combined. Allow this sensitized collodion to rest for three hours before use. The mixing must be made in a non-actinic light, and the collodion must be kept in the dark. In this state the collodion will not keep for many days, therefore not much more should be sensitized than will be speedily required. Varnish the edges of the glasses a quarter of an inch with india-rubber and benzole varnish, and coat the plate with the sensitive collodion. Allow it to set well, and immerse in a dish of water till all greasiness disappears ; next put the plate in a dish containing a solution of tannin, fifteen grains

to the ounce of water; or better still, use the following solution :—

Tannin	10 grains.
Gallic acid	3 „
Grape sugar	5 „
Alcohol	10 minims.
Water	1 ounce.

Prepare sufficient of the above—it can be used over and over again—as follows ; dissolve the gallic acid first in the water, using heat; next add the tannin, then the grape sugar. Filter, and, when cold, add the alcohol.

Allow the plate to remain in this solution three minutes. Let the plate dry evenly and quickly in any convenient manner, and it is ready for use. Expose three times the time required for a wet plate. Use the alkaline pyro developer, adopting all the precautions described in the use of the bromide of potassium. If there be any difficulty in obtaining the ultimate intensity, the acid pyro and silver may be used. The fixing may be done with cyanide, as that has a tendency to counteract any splitting of the film on drying.

When experience is gained in working the process, the quantity of nitrate of silver in the collodion may be increased to twelve or even thirteen grains, accompanied with increased sensitiveness in the plate.

A very simple method of using up the residues of sensitized collodion is to add an equal quantity of plain bromized collodion, reserving the necessary addition of nitrate of silver until a few hours before it is required for using the next time. This method prevents deterioration and loss of material.

PART III.

ABOUT LIGHT, AND HOW TO USE IT.

The preceding portion of this Manual has been occupied with the description of the proper methods of producing sensitive wet and dry plates. The pupil being supposed to be proficient, will now have to apply this knowledge to a practical end; he may attempt portraiture, still-life, landscapes, copying paintings, or the thousand and one other applications of the art, but he will speedily discover that the next most important thing he has to learn is the management of his light. On the proper management of it depends the chief success of the photographer. This is the most difficult part of the art to teach, because no absolute rules or exact formulæ can be laid down. He will also have to learn that on this subject, no reliance is to be placed on lens, camera, and chemicals. These, valuable enough in their places, can teach him nothing here. He must go to the fountain head—light itself. He must teach himself to observe the apparent changes that take place on objects, according as the light plays upon them. It is not sufficient to *see* objects; he must endeavour to see them with the appreciative and discriminating eye of an artist, so as to know what are fit objects for the camera, and what are not. The same object may at one time be desirable, and at another time otherwise, merely according to the manner that the light falls on it.

Whatever light falls on, it enlightens, whitens. White is

the representative of light; black, that of darkness. If an object is wished to be represented white it must be placed in the light; if black, the light must be excluded from it; if partially white and partially black, the light must be allowed so to fall on it that, while the parts that are to be represented white must be illuminated, the others that are to be black must be protected from illumination.

These principles—almost too simple to be gravely stated—contain all that is meant by "management of light." They apply universally to landscape, architecture, portraiture, and everything else. Before a photographer proceeds to take a picture he should settle in his own mind what sort of picture he intends it to be, and not wait until it "comes out" to see if it will "do." It is too late then. A man should definitely start with a fixed idea in his mind, and let his work carry it out. For instance, if he admire in portraits a broad, bold style, where the lights and shades are strongly marked and the whole picture very brilliant, let him arrange his light so that the sitter has the light falling on him in that manner, and then aim, by camera and chemicals, to accurately copy his illuminated model. If a soft and delicate picture—where half-tone abounds—be preferred, let the light so fall as to show these half-tones on the face of the sitter. Then, as before, let mechanical photography do the rest. But the first and primary condition is not to expect, by any modification of mere photography, to produce the effects that are legitimately due to light. For example, if a sitter is so placed in a studio as to have the light and shade strongly shown on the face by the arrangement of the light, although an under-exposed or an over-intensified negative will exaggerate the same, yet an over-exposed or under-intestified

one will not make a soft picture. In like manner, if a sitter be lighted very uniformly, though an under-exposed picture will increase the contrast, yet no management of chemicals will make it a brilliant one. The point wished to be insisted on is, that the effects due to arrangement of light should be considered quite distinctly from the effects of manipulation. A photographer can do much by both the one and the other; but he should not confound the two, nor call on one to supply the shortcomings of the other.

If the idea be distinctly recognised, that as the light falls on an object so is it represented, the question of its "management" is very simple; for the lens may be regarded as an eye, and as capable of representing objects, with the lights and shadows, only as it sees them. The photographer can, therefore, by the use of his own eye judge of the effect that his lens will see, and he may take the photograph or not, according to the suitability of the light. In out-door photography this is of the greatest consequence, for some views are best illuminated early in the morning, others late in the afternoon, and some only about midday.

In a photographic glass-room the photographer should have the light entirely under his control; then it is a question of placing his sitter or object nearer or farther from the window, and of the arrangement of curtains and blinds, so as to cause the lights and shades to play on his sitter's face as he would like to see them in the finished photograph.

The primary idea however is, before taking any photograph, to observe how the object is lighted, and to take this into consideration as of equal importance with the exposure the plate will receive, or the development that will follow. If the question of "lighting" be regarded in this true yet

simple manner, the photographer has the key to the whole subject, and all the rest will depend on the taste he exercises in using his knowledge.

HOW TO CONSTRUCT A GOOD GLASS ROOM.

As the character of a photographic portrait is largely determined by the mode in which the light is permitted to fall on the sitter, as shown in the preceding article, it is therefore of the gravest importance that a glass room should be so constructed as to supply the greatest facilities for the management of the light. To have a well-constructed glass room, then, is a matter of vital importance as well to the amateur as to the professional photographer, but especially to the latter. Such a room ought to permit the sitter to be properly and quickly lighted, so that good portraits can be taken with expedition. It should be adapted for working in dull weather as well as bright, and the sitter should be able to have either side of the face taken without turning the eyes to the light. The room should be well ventilated, so as to be not too warm in summer, but sufficiently so in winter; and no fumes of chemicals should be present. Many of these desirable conditions will depend on the size and aspect of the room.

During the last few years glass rooms have been built in every variety of form; but after a fair trial, practical men are satisfied that an oblong room with a ridge roof is the very best. Local necessities will often dictate the size, shape, and aspect of a room; when, however, the photographer can have control, the writer believes that a room built as he is about to describe will be found to be the most perfect for

either amateur or professional photographer—and especially for the latter—that present knowledge can suggest. If circumstances permit, the room should be built on the ground floor. It should be oblong in form, the length running from east to west, so that one of the long sides should have a clear north aspect. Its length should not be less than 25 feet, and need not be more than 40 feet. The width may be 16 feet, but must not be less than 10 feet. Although called a "glass" room, it should be all built of substantial brickwork, except the side facing the north and half of the roof on the same side; these should be of glass. The south side of the roof should be slated, and the whole building should, if possible, on that side be built against a wall much higher than itself, so as to screen it from the sun at midday. Buildings, trees, or other objects should protect the ends from the morning and afternoon sunshine. A room built in this manner will be lighted only from the north, and will have the most uniform and soft light that it is possible to obtain. Undisturbed by sunshine, morning, noon, and afternoon, his light will be so steady and uniform that the photographer will be able to produce his negatives with almost absolute certainty.

Suppose a medium of the sizes referred to be adopted—say 32 feet long by 12 feet wide—a handsome apartment will be formed, large enough to take a numerous group, and to contain the apparatus and furniture of a well-appointed studio. The sides, up to the eaves of the roof, should not be more than 7 feet, and need not be so much; the height to the ridge should be in proportion, from 10 to 12 feet high. This will give a good slope to the roof, helping to keep the glass clean, and to prevent leakage, to which fault flatter roofs are

very subject. The glass should not go to the ends of the room, but about 6 feet of each side should be bricked up, and the roof should be slated at each end about 6 feet also. If the room be 32 feet long, this will yield about 20 feet length of side and top light, all of which should have opaque blinds. As it is not advisable at any time to use more light than is necessary to illuminate the sitter, not more than half the light provided should be used at one time. A background should be placed at each end of the room, and at whichever end the sitter is placed, the blinds should be opened on that side only ; the darkened portion of the room will be pleasant for the sitter to look into, and useful to place the camera in. When the sitter is taken at the other end, everything must be reversed. As the majority of portraits are best taken with three-quarter face—the light on the near side and the shadow on the retiring side of the face—and also as a more agreeable likeness and a pleasanter expression and definition of the eyes are secured when they are allowed to look away from the light, these desirable conditions are entirely secured by this arrangement of light. The side of the room should be papered or painted of a rather light colour, but not white, and the reflection from this will, in nearly all cases, be sufficient to prevent dark shadows on the least illuminated side of the face. A moveable screen reflector made of light calico may be used according to circumstances to modify the dark shades. Considerable varieties of effect may be caused by placing the sitter nearer or further from the window. By having a background at each end of the room, either side of the face may be taken equally well, and this is a point by no means to be undervalued by the portraitist, especially as most persons have one side of the face better than the other.

In short, no glass room is in any degree approaching a perfect one unless the sitter can be equally well taken in any position or view; the light must always be made to suit the sitter, and not the sitter's position determined because of the arrangement of the light.

Though by no means so necessary as the points alluded to, yet no glass room is complete without a perfect system of ventilation, so that the greatest amount of coolness in summer and warmth in winter may be obtained, and pure air always. A room built as here described will be much more healthy than the usual conservatory-like structures, which are cold in winter, hot in summer, leaky in wet weather, and dirty all the year round. Yet all rooms devoted to photography should be thoroughly ventilated, and the chief point in ventilation is to provide for the escape of the hot and vitiated air which rises to the top of the apartment. In the glass room, therefore, the very ridge is the place. Doors and side windows are well enough for letting in cold air, for which, by-the-bye, there is no room till the hot air escapes; but the heated atmosphere crowds to the top of the room, eager to go out in that direction, but objecting to go in any other. Provide it with proper means to get out, and the colder and purer air will always find a way to take its place. A good glass room should also be provided with means to heat it in wet and cold weather. If a hot water system cannot be used, a good household grate, giving a cheerful fire, may be provided on the bricked-up side. Above all things, that deadly abomination a gas stove, should be avoided. By attending to these minor points, though they are not photographic essentials, the sitter will feel and look more pleasant during the ordeal, and the photographer himself will derive greater health and

pleasure in following his business ; thus these smaller matters will help to make a well-constructed glass room more useful and perfect.

SARONY'S PHOTO-CRAYON PORTRAITS.

THIS is a clever and beautiful method of producing a peculiarly delicate style of portraiture, consisting of a transparency on glass, the lights of the portrait being formed by a tinted paper backing. The picture is made from an ordinary portrait negative, which should be soft, sharp, clean, and full of modelling. Place the negative in a copying camera for transparencies, or in the window of a darkened room, as described in the article, page 85, and proceed to make a transparency from the negative. An ordinary carte-de-visite vignette, or a cabinet sized head, is most suitable. Provide a screen outside the camera, and in advance of the negative, of a somewhat oval shape, and allow the light to pass through this aperture on to the negative so that only the head and shoulders are visible, the rest being vignetted gradually away. Make the image to yield a head of about an inch and a half in size. Any ordinary good bromo-iodised collodion will do if half a grain of chloride of ammonium per ounce be added. The nitrate bath should be as nearly neutral as can be worked without fogging. The developer should consist of

Pyrogallic acid	...	...	2 grains.
Citric acid ...	...	...	½ grain.
Glacial acetic acid	...	...	30 minims.
Water... ...	...	...	1 ounce.

The exposure should be abundant, so that the image rapidly

appears when the developer is applied. Very little development is required, as the image must be a very thin one and of a purple-brown colour. If the image is under-exposed, or too much developed, it will be a disagreeable colour and be deficient in delicate definition. It must be remembered that it is only a very thin transparency that is required. During development the action must be carefully watched, something like developing a glass positive, and directly the details are visible — without washing off — saturated solution of hypo must be flooded over the plate to fix it. When fixed the plate must be well washed and dried, and, if the operation is perfect, the transparency will show, when laid on white paper, as a delicate soft portrait with a white vignetted margin, the whites in all cases being supplied by the paper backing. White paper, however, is not the best for these pictures, but Mr. Sarony has provided a series of tinted papers with cleverly executed hatchings which, if the proportions of the transparency be made to suit, form an excellent backing, and the portrait then appears as a beautifully executed work of art, combining the accuracy of the photograph with the beauty of a crayon drawing. The transparency has to be varnished with a colourless varnish, and the backing of the hatched paper has to be placed behind in contact with the varnished surface, but not to be attached to it. Much of the soft delicate beauty of these pictures is due to the fact of the tinted backing not being in absolute contact with the image. Great scope is afforded for the exercise of artistic feeling in the production and mounting of these portraits, and, when skilfully executed, they form some of the most beautiful pictures ever produced by photography. Mr. Sarony has secured a patent for the process,

and for a reasonable consideration supplies both the right to use the process, and also a stock of the necessary hatched paper backings.

A very ingenious method has also been devised for producing these pictures by the aid of the magnesium light, which answers even more perfectly than daylight. The apparatus can be obtained from the usual Photographic Warehouses.

TRANSPARENCIES FOR DECORATING WINDOWS, AND FOR THE MAGIC LANTERN.

A VERY interesting application of photography is the production of transparencies for window decorations and for the magic lantern. They may be produced by the dry or the wet process. The first proceeding is to obtain a suitable negative. It should be clear, clean, and very sharp. The high lights should not be too opaque, but full of half-tone, and the shadows free from fog and full of detail. There ought to be an entire freedom from all smears, markings, stains, spots, and comets. Although there is no fixed size for the magic lantern, yet $3\frac{1}{4}$ inches square is a usual size, and for which the ordinary stereoscopic negative is well adapted; but every person will, of course, make the pictures the dimensions to suit either the lantern he uses, or the window he wishes to ornament. If the negative be the same size that the transparency is wished, the proceeding is very simple, as any of the dry processes may be employed—the "collodio-bromide" by preference, in consequence of the rich tone it gives. The negative has to be placed in the printing-frame, and the dry plate put in contact, as in ordinary printing A few seconds' exposure in

diffused light, varying with the intensity of the negative, will be enough; or gaslight may be used, when a few minutes will be necessary. The plates must be developed according to the directions given for each process; pyrogallic and citric acid yield a bluish-black, and pyrogallic and acetic acid a brown-black tone. The picture, if intended for the magic lantern, should not be varnished, unless the blacks are foggy, but mounted by putting another glass the same size to protect the collodion film, and binding the edges like a passe-partout. If intended to be suspended as a transparency, it should be varnished and the collodion side protected with a *ground* glass. The edges may be secured like a passe-partout, to keep out the dust, and may then be framed according to taste.

If, however, the negative from which the transparency is to be made is larger or smaller than the size required, the lens and camera must be employed, and the negative must be copied *by transparency*. Many methods of doing this will suggest themselves to ingenious persons; one of these is by placing the negative in a window, all the rest of which is darkened, and copying the negative by the light that thus streams through it; the rest of the room must, of course, be in complete darkness.

Another and a neater plan is by the use of "a copying camera for transparencies." This instrument is a kind of double bellows-bodied camera; that is, another body is provided *before* the lens, in addition to the usual body behind it. This extra body is provided with sliding holders, to receive different sized negatives. The screen carrying the lens can be freely moved backwards or forwards, so as to approach either the negative or the ground

glass, so that either a reduced or an enlarged copy may be made. To use the camera, place the negative in its holder at one end and the usual ground glass in the other, screw the lens on to the central screen, and put it in its place. If the copy is required to be exactly the size of the original, place the negative twice the focal length in advance of the lens, and the ground glass the same distance behind. If the size is to be reduced, push the negative further from the lens, and put the ground glass nearer; if it is to be increased, reverse the plan, putting the negative nearer and the ground glass further from the lens. How much nearer or how much further the lens must be from the ground glass, or from the negative, depends on the focal length of the lens, and on the desired degree of enlargement or reduction. This point may, however; be remembered, that neither the ground glass nor the negative must be put so near to the lens as its focal length, or no image will be formed. See Table, page 93.

The adjustment made, the camera may be inclined to the north sky; and the light streaming through the negative will form its image on the ground glass in the usual manner. A quarter-plate double combination lens, with central diaphragms, will be found very convenient for this work. First focus with open aperture, then put in the smallest stop, and proceed as if for producing an ordinary negative; but instead of a negative, a transparent positive will be produced. Most usually the ordinary wet method will be found the easiest and simplest. Pyrogallic acid or iron may be used as a developer, the former by preference, as yielding a better tone and denser image. If the latter be used, and the tone be not approved, intensify, after fixing, with pyro 2 grains, citric acid 1 grain, water 1 ounce; or, to produce blacker tones, wash the

plate well from the hypo or cyanide fixing solutions, and pour on a saturated aqueous solution of bichloride of mercury, until a grey appearance is seen on the plate, then wash well, and apply solution of iodide of potassium, 2 grains to one ounce of water, which produces a greenish-grey image ; wash, and well finish with a solution of ammonia 1 drachm, water 1 ounce, which will change the image to a black colour. If the first deposit from the developer was not very dense, these operations may be repeated ; the densest blacks may be obtained by these means.

It has already been stated that the pictures for the lantern need not be varnished. If, however, varnish be used, crystal varnish, drying without heat, will be found better than a thick spirit varnish, which would probably show markings when magnified on the screen. If the picture, on drying, be found too opaque, varnish will be found to restore transparency.

HOW TO PRODUCE DIAPHANOTYPES.

A "DIAPHANOTYPE" is a coloured photographic portrait having the peculiarity of being a miniature coloured in oils. They are very easily produced, and much less artistic skill is required than their finished appearance would indicate. Produce a good photograph on plain paper with all the delicate half tones of the negative well preserved. Let it be deeply printed, as when it is rendered transparent by the balsam its force is considerably reduced. Do not attach the print to cardboard ; retouch the unmounted print in the shadows of the drapery, but do not interfere with the face. Place the print in contact with a

piece of the best white plate glass, using the following solution :—

Canada balsam	...	...	...	2 ounces.
Turpentine	...	...	...	1 ounce.

Pour this over the glass in much the same manner as collodion and lay the print down on it, and with the finger or a soft pad commence from one corner carefully to press out all air bubbles. When the picture is sufficiently set to paint upon, work in the local colours of the face, drapery, and accessories in oil colours, having a careful regard to the general outlines. It is not necessary to paint in all the shadows as carefully as an artist would do, as the transparent photograph supplies these. Any one with but a little artistic skill can in this case be his own artist. When the work is done the effect is very rich and mellow, with the certainty of retaining all the fidelity of the photograph.

THE IVORYTYPE.

Make a good print on plain paper ; if the portrait is that of a fair person let the tone of the print be warm, if of a dark person let it be a cold tone. The print has to be coloured on the surface as if it were to remain as an ordinary coloured miniature, only the colouring must be higher and stronger to allow for the toning down it will presently receive. In this stage it will look like an ordinary photograph over-coloured. The next point is to communicate to it the softness, creamy delicacy, and transparency of an ivory miniature. This is effected by attaching it in contact to white plate glass by white wax and gum dammar. Melt in a jar by gentle heat two ounces of the best white

wax, and add a piece of gum dammar about the size of a hazel nut. When these are thoroughly mixed, place a little on the clean glass plate which is to receive the picture. Heat the plate gently, and when the gum and wax is melted and flows over the plate the coloured photograph must be carefully laid down on the melted wax, the greatest care being taken to avoid air bubbles and to preserve an equal layer of wax all through. Should air bubbles show when the plate is cold, or the wax appear unequally thick, the plate can be re-warmed, and with a warm palette knife the irregularities may be removed by gentle pressure.

INSTRUCTIONS RESPECTING CAMERAS FOR COPYING AND ENLARGING.

PICTURES are sometimes required to be copied of an enlarged size. Small portraits, three or four inches square, enlarged to 10 by 8, or 12 by 10 inches, are the most usual examples. For this work a *copying camera* is required, that is, one with a long, expanding body, which should be of leather, accordion fashion, so that it may be used at various distances.

The size of this camera will be determined by the dimensions of the largest plates proposed to be used, and by the focal length of the enlarging lens.

Let a case be supposed: it is required to enlarge a picture on a $2\frac{1}{2}$ by 2-inch plate to fill a 10 by 8-inch one. For this work a good quarter-plate lens, provided with central diaphragms, will answer. The *equivalent* focus of these lenses is usually about six inches. The distance the ground glass should be from the back lens must be calculated to know the length of the camera required. The rule that determines this is simple and easy to be remembered: *Multiply the*

equivalent focal length of the lens to be used by the number of times of enlargement, and add the focal length to the product. Thus, the picture is to be enlarged four times, the focal length of the lens is six inches: four times six are twenty-four; now add the focal length—six inches—and thirty inches is the distance for the ground glass to be behind the lens; therefore, a camera that will expand to three feet will be ample. The distance for the picture to be placed in front of the lens is always more than the focal length, and less than twice the focal length; in this instance it will be $7\frac{1}{2}$ inches. If a different lens were employed, say a whole-plate lens with about 12-inch equivalent focus, the camera would have to be 5 feet long. The above examples will show that the focal length of the lens, and the number of times of enlargement of the copy, determine the length of the copying camera.

THE "EQUIVALENT" FOCUS OF A LENS.

A TERM has been used in the preceding article which it is important should be thoroughly understood—the "equivalent" focal length of a lens. The power of a lens is determined by its diameter and its focus. The diameter of a lens determines the amount of light it will admit; the length of its focus determines the size of the image it will produce. A short focus lens produces a small image, without any reference whatever to its diameter. A long focus lens, also without regard to its size or diameter, produces a large image. The size of image, then, that any lens will produce is entirely governed by the length of its focus. But we always speak of the optical instrument we use as being a "lens," whereas it is made up of several lenses. Every indi-

vidual lens, according to its form, has a definite focus, but when several are united the focus of the instrument is a compromise of the focal lengths of all the lenses in the compound, each one modifying the other. This compound focus is called the "equivalent" focus of the instrument, because it produces an image of an object, at a definite distance, of the same size that a single lens of the same focal length would do at the same distance. Hence the compound focus is equal to, or equivalent with, a single lens of that focus. It might have been called the "general" focus, or the "combined" focus, or the "absolute" focus; but when its meaning is understood, the word "equivalent" is better, as it is more exact. The length of focus, then, of a photographic optical instrument is determined by, not the diameter of the glass, not the number of the lenses that may be united in the combination, but by the size of the image that the instrument will produce. A familiar example may perhaps aid in making this subject clearer than a general statement. One of the simplest lenses that can be employed is a common reading or magnifying glass. Take such a glass, and by the aid of sunshine produce the brightest and most concentrated point of light, say on white paper, using the lens as a burning glass. Measure the distance from the glass to the paper, and that is the focus of the lens. Let us suppose it to be six inches; that is, the focal length of that lens, and, for all practical purposes, it will serve as the standard to judge the focal length of the other lenses. Let the reading-glass be now mounted so as to be used in a photographic camera, and let it be placed at such a distance from a man six feet high as to produce an image on the ground glass of, say, two inches. Now replace the reading-glass by an ordinary photographic

portrait combination, so that the slot of the central diaphragms corresponds with the place of the reading-glass, the man and the camera remaining undisturbed. The image given now on the ground glass will be either the same size, two inches, or it will be greater or less. If the image is the same size, then its equivalent focal length will be six inches, because it produces an image equal in size to a simple single lens. If the image is smaller, then its equivalent focal length is shorter than the single lens—that is, it is less than six inches. If the image be larger than two inches, the equivalent is longer; and the difference in size will proportionally determine the difference of the equivalent lengths of focus. If the portrait combination give an image of four inches, then its equivalent is twice that of the reading-glass—that is, it is twelve inches equivalent focus. If it give an image, however, of only one inch, then its equivalent focus is only one-half of the reading-glass—that is, three inches. This illustration will make clear what is meant by the term, and what is the value of the term, "equivalent" focus. When the equivalent focus of a lens is wished to be determined, a much simpler method can be given, which is sufficiently accurate for practical use. Place an object, say three inches in diameter, before the lens; adjust the camera and lens so that the image of the object is of exactly the same size, three inches. Remove the lens and measure the distance from the object to the ground glass of the camera. One-fourth of this distance will be the equivalent length of the focus of the lens. If the distance were two feet, then six inches is the equivalent focus of the lens.

In the following table of enlargement and reduction all the calculations are based on the equivalents of focus of the lenses.

TABLE OF ENLARGEMENT AND REDUCTION;

GIVING THE DISTANCES BETWEEN THE LENS AND THE OBJECT, AND THE LENS AND THE FOCUSSING GLASS, FOR ENLARGING OR REDUCING FROM THE SAME SIZE TO TEN TIMES THE SIZE OF THE ORIGINAL.

Focus of Lens.	Number of times of enlargement or reduction.									
	Same Size.	2	3	4	5	6	7	8	9	10
Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
4	8× 8	12 × 6	16× $5\frac{1}{3}$	20 × 5	24× $4\frac{4}{5}$	28 × $4\frac{2}{3}$	32× $4\frac{4}{7}$	36 × $4\frac{1}{2}$	40 × $4\frac{4}{9}$	44 × $4\frac{2}{5}$
$4\frac{1}{2}$	9× 9	$13\frac{1}{2}$× $6\frac{3}{4}$	18× 6	$22\frac{1}{2}$× $5\frac{5}{8}$	27× $5\frac{2}{5}$	$31\frac{1}{2}$× $5\frac{1}{4}$	36× $5\frac{1}{7}$	$40\frac{1}{2}$× $5\frac{1}{8}$	45 × 5	$49\frac{1}{2}$× $4\frac{95}{100}$
5	10×10	15 × $7\frac{1}{2}$	20× $6\frac{2}{3}$	25 × $6\frac{1}{4}$	30× 6	35 × $5\frac{5}{6}$	40× $5\frac{5}{7}$	45 × $5\frac{5}{8}$	50 × $5\frac{5}{9}$	55 × $5\frac{1}{2}$
6	12×12	18 × 9	24× 8	30 × $7\frac{1}{2}$	36× $7\frac{1}{5}$	42 × 7	48× $6\frac{6}{7}$	54 × $6\frac{3}{4}$	60 × $6\frac{2}{3}$	66 × $6\frac{3}{5}$
7	14×14	21 ×$10\frac{1}{2}$	28× $9\frac{1}{3}$	35 × $8\frac{3}{4}$	42× $8\frac{2}{5}$	49 × $8\frac{1}{6}$	56× 8	63 × $7\frac{7}{8}$	70 × $7\frac{7}{9}$	77 × $7\frac{7}{10}$
8	16×16	24 ×12	32×$10\frac{2}{3}$	40 ×10	48× $9\frac{3}{5}$	56 × $9\frac{1}{3}$	64× $9\frac{1}{7}$	72 × 9	80 × $8\frac{8}{9}$	88 × $8\frac{4}{5}$
9	18×18	27 ×$13\frac{1}{3}$	36×12	45 ×$11\frac{1}{4}$	54× $10\frac{4}{5}$	63 ×$10\frac{1}{2}$	72×$10\frac{2}{7}$	81 ×$10\frac{1}{8}$	90 ×10	99 × $9\frac{9}{10}$
10	20×20	30 ×15	40×$13\frac{1}{3}$	50 ×$12\frac{1}{2}$	60×12	70 ×$11\frac{2}{3}$	80×$11\frac{3}{7}$	90 ×$11\frac{1}{4}$	100 ×$11\frac{1}{10}$	110 ×11

This Table (page 93) shows at a glance the distance the object must be in front of the lens, and the distance the ground glass must be behind, for reducing or for enlarging to ten times the original size of the object, and the calculations are for lenses from 4 to 10 inches equivalent focal lengths.

For enlarging, the figures on the left side of the × give the distance from the lens to the ground glass, and the figures on the right side give the distance in front of the lens: for reducing, exactly the reverse rule applies. If the × be taken to represent the lens, the figures on each side will show how far before the lens the object must be put, and how far the ground glass must be placed behind the lens, according to the focal length of the lens employed, and the degree of enlargement required.

For single lenses the distances may be measured from the lens itself. An exact rule cannot be given for double combinations where the equivalent length of focus is unknown, but for practical use the point may be measured from the central diaphragms, or, if they are not provided, from midway between the inner surfaces of the front and back lenses.

To use the Table: Suppose a picture has to be copied three times larger with a lens of 5-inch equivalent focus, and it is required to know how much the camera must be drawn out. By referring to the side column, "focus of lens," select 5, and on the horizontal line 3 will be seen 20 × $6\frac{2}{3}$. The camera must be lengthened for the ground glass to be 20 inches from the lens, or the part of the lens measured from, and the object must be $6\frac{2}{3}$ in advance of the same point. If the lens were 8-inch focus, the Table shows that the picture must be $10\frac{2}{3}$ inches in front, and the ground glass 32 inches behind

the lens, and so on for various focal lengths and different degrees of enlargement.

STEREOSCOPIC PICTURES.

The principle of Stereoscopic Pictures depends on the production of two pictures taken of the same object at slightly different points of view. Two ordinary cameras may be used, each provided with its own lens and its own plate; or the same camera may be used twice, moving it slightly on one side in the second picture, to obtain the necessary difference in the point of view. If the difference between the two points of view be considerable, the effect in the stereoscope will be that of exaggerated relief and distortion. Under all ordinary circumstances the best effect is produced by the use of the binocular camera, as the two lenses are then employed in the simplest and readiest manner, and the pictures produced have the relief of nature. It is also a great convenience to have both pictures on one glass, as one preparing of the plate serves for each. As the two pictures are thus exposed simultaneously, the same objects will be in both; whereas when they are exposed at different intervals of time, only still-life objects can be produced with certainty. The binocular camera is therefore recommended. In selecting the points of view, particularly in landscapes, it is especially desirable to have some objects in the foreground, otherwise the picture, when seen in the stereoscope, will be tame and flat. Sometimes a post, an old tree, even a few twigs, will be sufficient; but it is of the highest importance that some object should be there, so as definitely to mark the foreground, and then all other objects will fall into their relative planes, and communicate the sense of relief.

When the binocular camera is used, the pictures, after being printed, must be cut and transposed, so that the right-hand one shall be placed on the left, and *vice versâ*. When many copies are wanted, it is better to cut the negative itself, transposing the two halves, and then glue them by the corners to another glass, and thus the paper prints will be printed right at once.

In producing stereo-negatives, a rather different treatment is required than for other pictures. It is not so much a brilliant picture, that may look well out of the stereoscope, that is wanted, as a soft and delicate one, that looks well in the instrument. In particular, there must be no masses of hard white light, or patches of deep black shadows without detail. The negative must be exposed sufficiently long in the camera to bring out all the details in the deepest shades; and in developing, the intensifying must not be carried so far as to fill up any of the details in the high lights. By these means a picture will be produced which, though somewhat lacking in brilliancy out of the stereoscope, will amply repay by the beauty of its details, when seen in it.

TO CLEAN PLATES THAT HAVE BEEN VARNISHED.

Soak the plates in a saturated solution of common washing soda, and allow them to remain until the film comes off without any friction. If the solution be made hot, a few minutes will be sufficient; but cold, they usually require from twenty-four to forty-eight hours' soaking. When the film leaves the glass freely, wash it well under the tap, and immerse the plates in weak nitric acid (water 5 ounces, nitric acid 1 ounce)

for a short time. Wash well again, dry, and treat it as a new glass.

As the varnished side can never be much depended on, it is a good plan to mark the *unvarnished* side with a diamond before cleaning; and to use the marked side for putting the next collodion film upon.

HOW TO USE THE SOLAR CAMERA AND PRODUCE LIFE-SIZE PICTURES.

By the ordinary method of copying, pictures can be obtained considerably enlarged, and with a satisfactory degree of definition; but a bound is soon reached, in consequence of the weakness of the light, when distributed over a large surface. To meet this difficulty, the Solar Camera has been invented by an American gentleman (Mr. Woodward), which supplies the means of illumination in so superior a degree, that a new impetus has been given to the production of pictures by enlargement.

The instrument is based on the principle of the solar microscope, and is intended to be used in direct sunshine. It consists of a large strong box, some 11 inches square, with sliding adjustments, like an ordinary camera. The front has adaptations for various lenses, but an ordinary half-plate portrait lens is the one usually employed. Inside of the camera, and near the back, is placed a large plano-convex condensing lens, 9 inches in diameter, 17 inches focus, with the plane side inwards. Firmly attached to the camera-back is a glass mirror, about two feet long, and nearly a foot broad. The negative to be enlarged is placed in a moveable partition between the condenser and the portrait lens.

To use this instrument, a room with a south aspect is selected. A strong table or bench is placed under the window to support the camera. The camera is placed with its back close to the window, all the light from which should be stopped out, except two portions, each about a square foot, through one of which the mirror should pass, and the other should be made yellow, to see to work by. A few feet from the camera is placed a screen on which is received the enlarged image magic-lantern fashion. This dark chamber becomes in fact a huge camera, in which the operator conducts all his operations. The picture to be copied must be a weak glass negative, with abundance of detail in the shadows, and not too dense in the high lights. An ordinary negative will not produce good pictures, being too opaque.

The picture should be very clear, clean, and sharp; it should not be varnished. Any size under a whole-plate may be copied, but a 5 × 4 or 1/2 plate is best. A sunshiny day must be selected, and the mirror so turned that it catches the solar rays and reflects them on the condensing lens. The size of the picture to be produced is determined by the distance the receiving screen is placed from the portrait lens; the further it is removed, the greater the enlargement. The apparatus must be so adjusted that when the picture is exactly in focus, the solar spark produced by the condensing lens must be precisely in the centre of the front surface of the portrait lens. By means of rack-work attached, the mirror can be moved in any direction to follow the motion of the sun. These movements can be made *inside* the room, which is a great convenience. A picture can be directly printed on albuminized paper in from one to three hours; but the mode generally adopted is to use a "development" process, such as described on

page 36. A few seconds' exposure may then be sufficient. The developing is conducted as there described, and with moderately careful management, pictures can be produced much better in brilliancy, sharpness, rapidity, and delicacy, than by any other enlarging means. So far as *size* is concerned, the operator is bounded only by the troubles of manipulation and *matériel*, otherwise there would be no difficulty in enlarging portraits to colossal proportions, and increasing half-plate pictures to ten feet dimensions. It is not to be supposed that the same degree of delicacy of definition is retained when this great enlargement is attempted, but the general truthfulness of effect and absence of distortion is really remarkable.

HOW TO INTENSIFY NEGATIVES AFTER THEY ARE VARNISHED.

When a negative has been once varnished, its character is supposed to be so settled that it is beyond the reach of alteration or improvement. It is certainly the best plan to so consider it; yet sometimes a negative becomes so weakened in the varnishing as to cause great disappointment. It is a consolation to know that a negative need not be given up as hopeless, even under these circumstances. The method of proceeding is to make a "Negative Intensifying Varnish" by adding tincture of iodine—alcohol 1 ounce, iodine 10 grains—to any good negative spirit varnish, until of a very deep sherry colour. Label the bottle, and keep it for special use. When a negative prints weak and without sufficient contrast, re-varnish with this varnish; pour on in the usual manner, allowing a few seconds for the yellow varnish to penetrate the

film, and dry by heat in the usual manner of varnishing the plate. The negative will be found to be changed to a more non-actinic colour that will take longer to print, and will produce a more brilliant impression on paper. Many weak, thin, foggy negatives may thus be made to produce passable prints. It is well to keep two varieties of this yellow varnish; one of an ordinary sherry colour, for negatives that only want a little intensifying; and another with a very deep port wine colour—by adding a greater quantity of tincture of iodine—and using this latter for negatives that are very weak and grey. Used with care and judgment, there is no question but that these varnishes will be found extremely useful in every photographic laboratory.

A varnish of this character may also be used with advantage for varnishing the plate in the first instance, if the negative is found to be not quite intense enough, as the iodine in the varnish unites with the silver deposit, and makes the deposit much more chemically opaque than the ordinary varnish, thus increasing the intensity of the negative.

It is scarcely necessary to say that judgment must be exercised in employing these expedients, and, though useful in cases of extremity, they should never be considered as the regular practice.

ON REDUCING THE INTENSITY OF NEGATIVES.

When a negative is too dense, and it is wished to reduce the intensity, the usual recommendation is to employ a strong solution of cyanide of potassium to dissolve away the excess of density. This method is effectual when there is an excess of deposit all over the plate, and where the deep shadows will

bear reducing, as well as the high lights. When, however, the density is in excess only on the high lights, and the deep shades are already too bare, this method is not only not useful, but positively pernicious ; for the cyanide has a tendency to attack the weaker shades even more than the dense high lights, and a negative so treated will be found to be more injured than improved by the process. By the use of perchloride of iron, used in the manner I am about to describe, such negatives may be materially improved and rendered frequently capable of producing perfectly satisfactory prints.

Perchloride of iron is a readily obtainable salt, highly deliquescent, very cheap, and very little goes a long way. Make a stock solution of (say) 30 grains to the ounce of water. When a negative has been fixed and washed, and is found too dense in the high lights, take a few drops of the stock solution and dilute till it has only a pale golden tint. Flow over the negative, or pour on to the particular part—face, shirt, hands, dress, or wherever the intensity is wished to be reduced. The solution acts immediately, according to the strength, making the deposit rather duller in colour. Wash well; no difference will be perceived except the slight dulness. The ordinary fixing solution, hypo or cyanide, has now to be poured over the plate, and, according to the action of the perchloride, so will be the reduction of the density.

The action is very simple, and easily understood. A layer of the reduced metallic silver forming the image is converted into chloride of silver by the perchloride of iron, which layer of chloride is instantly dissolved off in the hypo or cyanide, thereby reducing the intensity. Where the silver is most

abundant on the negative, there the perchloride most readily acts, and this constitutes its most useful peculiarity. It requires most carefully using, or the greater part of the deposit will be changed into chloride of silver, and be soluble in the fixing bath.

It is best to experiment on a waste plate or two before trying it on a valuable negative. If the negative is not enough reduced by the first application of the perchloride and fixing solutions, the action may be repeated again and again, until just the desired amount of deposit is left. This is, perhaps, the safest method of using the process: by repeated application of the two solutions.

The perchloride solution should be used very dilute, scarcely coloured; it has no tendency to stain, nor eat away the weakest half tones. The fixing solution acts immediately. All that it dissolves it does at once, so that but little time is lost. A good washing is required after the hypo or cyanide, but the perchloride is rapidly washed away. Everything may be done in open daylight.

HOW TO REMOVE SILVER STAINS FROM THE HANDS.

RECENT stains on the hands are more easily removed than old ones. On the same day they are made they may be easily taken away. Wash the hands well in hot soap and water, and get off the adherent metallic silver with a nail-brush, then rub the stain with a flat piece of pumice-stone; if the skin be not too tender, the greater part of the stain may thus be removed. Finish with a piece of cyanide of potassium, by rubbing the hand, while still wet, on the stained part, and the stain will disappear.

Older stains are not so easily removed. It is a good plan to use all available mechanical means before having recourse to chemical ones to remove the stains; hence the hands should be well washed with warm water with plenty of soap; this softens the hard skin; next use the pumice-stone, and with friction remove the mark as much as possible without making the skin smart. Take a crystal of iodide of potassium, and, just dipped in water, rub it on the mark till it changes it to a yellow patch, wash, and use the cyanide till it disappears.

Another method is to keep a saturated solution of cyanide of potassium in one bottle, and a solution, ten grains to the ounce, of iodide of potassium, to which has been added as much iodine as it will dissolve, in another bottle. Touch the stain first with the iodide solution, wash, and then use the cyanide, rubbing it on the yellow stains. The skin on the back and sides of the hands is more delicate than on the inside, and will not bear much friction.

The stain on the hands, if left alone, generally disappears in about a week. The nails are more difficult to clean; scraping with a penknife, after the rest of the hand has been cleaned, is the best proceeding.

Cyanide must never be used to the hands when the skin is cut, scratched, or in any manner injured, as not only immediate pain, but ultimate danger, may result from the absorption of the poison.

REMOVING SILVER STAINS FROM LINEN.

Stains should always be removed from linen before it is sent to be washed and ironed. The heat from the ironing tends to make them more indelible, and always renders the removal

more difficult. Wet the part stained, and put on a few drops of a saturated solution of cyanide, or rub it with a solid lump; if the mark does not quickly disappear, wash, and put on a drop or two of the iodine solution mentioned in the preceding paragraph; the stain will now quickly change colour, and a little cyanide will easily dissolve it. When the linen is double, and the stain goes through, the solutions must be applied to each side.

REMOVING YELLOW IRON STAINS FROM LINEN.

Sometimes operators' wristbands are as much stained by the iron as by the silver solutions. Yellow stains, commonly called ironmould, are easily removed by hydrochloric acid, or hot solution of oxalic acid, washing well in warm water afterwards.

ON THE PREPARATION OF IRON DEVELOPER SO AS TO PRODUCE DENSE NEGATIVES.

When nearly the right amount of intensity is supplied by the iron in the first instance, the plan of giving a little increased density to the high lights of a negative by pyrogallic and silver is a very satisfactory mode of working; but when the original deposit is thin, grey, and metallic, then is felt the shortcomings of the iron developer; for not only does the image require a great addition of strength, but it also unwillingly takes the intensity. Under these conditions the picture requires several applications of the pyro and silver; the image has to be built up; and when the required density is produced, there is usually found a considerable loss of

delicacy. The more forcing the image requires to become dense, the less satisfactory is the result. In a well-constructed portrait studio, and with skilful manipulation, this defect, the absence of primary intensity, exists in the least degree; but it is chiefly found in working in the open air, where the sky forms a large portion of the picture; or in using samples of collodion containing a large degree of bromide; in copying some kinds of pictures; in using a collodion giving only a thin and blue film; and in using weak nitrate baths.

Next to nitrate of silver, no substance has engaged so much photographic attention as gelatine. In the beginning it was pressed into the service of photography; and more or less, through thick and thin, it and photography have stuck together to the present hour.

Gelatine added to the iron developer appears to act beneficially, both mechanically and chemically. By the increased glutinous properties it gives to the solution, it seems to flow more steadily and certainly over the collodion surface, so that, not hesitating or running into irregular lines, it does not cause the stains and markings that it otherwise is prone to. By this means the developer may be poured on more deliberately, and less solution will be required for the plate; the quantity of nitrate of silver thus becomes less diluted; and from this cause it tends to produce a more dense picture. The gelatine acts chemically by restraining the iron from acting with its usual violence, so that the silver, instead of being very quickly deposited, is done so more slowly, and in the ratio of the action of light itself. It also causes the deposited silver, instead of being thin and grey and transparent, to be dense and brown and more opaque. Moreover it

has a great tendency to prevent the silver depositing where the light has not acted, thereby keeping all the deepest and faintest shadows very pure, thus relatively increasing the density of the negative.

There are several ways in which gelatine may be added to the iron developer. Mr. Cherrill's method is well adapted where considerable intensity is required, as there is no difficulty in obtaining any amount whatever. Mix 1 ounce, by measure, of ordinary sulphuric acid with 1 ounce of water; let them cool. Then add 120 grains of gelatine; when dissolved, add a few ounces of water (say 5) and neutralize with ordinary ammonia. Add an ounce of glacial acetic acid, and make up the total quantity to 20 ounces of solution. To form a developer, prepare a 20-grain solution of protosulphate of iron, and add to each ounce from 10 minims to 1 or even 2 drachms of the above sulphuro-gelatine mixture, according to the intensity desired, remembering that the intensity will be just in proportion to the quantity of the mixture added.

The next developer is the one I most recommend:—

Glacial acetic acid	2 ounces.
Distilled water	8 „
Nelson's gelatine... ...	120 grains.

Mix these together, and in a short time the gelatine will dissolve. A little agitation, or the application of heat, will facilitate the dissolution. Then add to it—

Distilled water	70 ounces.
Protosulphate of iron	2 „

This developing solution does not keep very well, and should not be made in large quantities. In cold weather it is apt to

gelatinize, but a little warmth sets it all right. This solution flows like oil on the plate, readily mixing with the free nitrate, and has little tendency to form stains and streaks.

The image comes out slowly and steadily, and not with a flash. The high lights, if the exposure be rightly timed, will be found to have nearly or quite the right density by the time the detail is out. If not sufficiently dense when fully developed, the solution may be poured on and off, and the density will increase; or a little fresh solution may be taken, to which a few drops of silver have been added, and any amount of intensity may be obtained. The images dry intense, and are not much reduced in varnishing.

These solutions admit of great variety of preparation, but whichever be used, persons are urged to take care and not make their negatives too intense. There is such a tendency in that direction, and this form of developer gives great facility.

VARIETIES OF THE IRON DEVELOPER.

Any given iron developer is a good one or not, just in proportion as it harmonizes with the other chemicals in forming a good negative. Any developer that works well may be allowed to remain; but persons who, in addition to what has been stated in the preceding article, may think there is room for improvement or variety, may find among the following solutions one that may suit them better than their usual one. The amount of alcohol necessary in the developer depends on the condition of the nitrate bath; though the quantity is omitted in all the formulæ, it must be understood that it is to be added according to circumstances. The more acetic

acid present, or the newer the nitrate bath, the less the need of alcohol, but for general use half a drachm of alcohol to each ounce of developer is a useful proportion.

No. I.

Iron	20 grains.
Acetate of soda	6 „
G. acetic acid	20 minims.
Water	1 ounce.

No. II.

Recommended by Mr. Rodgers, St. Andrews.

Iron	2 ounces.
Formic acid	$1\frac{1}{2}$ „
Sulphuric acid	5 minims.
Water	$16\frac{1}{2}$ ounces.

No. III.

Iron	10 grains.
Sulphate of copper	5 „
G. acetic acid	15 minims.
Water	1 ounce.

No. IV.

Recommended by Mr. Hislop.

Iron	15 to 20 grains.
Loaf sugar	50 „
G. acetic acid	10 minims.
Water	1 ounce.

No. V.

Iron	½ ounce.
Epsom salts	1 „
G. acetic acid	½ „
Water	16 „

HOW TO PRODUCE OPALOTYPE PICTURES.

When pictures are printed on opal glass instead of albuminized paper, they possess a peculiar beauty, due to the nature of the glass. Any method for producing glass transparencies will also serve for these pictures, only the printing should not be carried so far. An over-printed opalotype is always a good transparency.

Opalotypes by the Wet Process.—It is only necessary to use opal glass instead of patent-plate, and all the directions that are given in the article "How to Produce Transparencies for Decorating Windows, &c." exactly apply. Should the colour of the picture not be agreeable, it may be toned with gold by any of the usual processes, taking care to use the solution about one quarter the ordinary strength.

Opalotypes by the Dry Method.—Any of the dry processes may be employed, and the plate may be used, either in the camera, or by direct contact in the printing-frame. The development may be conducted the same as for a transparency, and, after fixing, may be toned the same as by the wet process.

Opalotype by Collodio-Chloride.—The ordinary method of producing opal pictures is by Mr. Wharton Simpson's elegant process, in which the sensitive chloride is held suspended in

the collodion. It is scarcely necessary to describe the preparation of the collodio-chloride, as it is already an article of commerce, and is sold with full instructions for use.

The plate when coated with this preparation and dried, is ready to be used in the printing-frame, and may be printed, fixed, and toned just as a paper print, except that no more washing will be required than for an ordinary negative.

The use of opal glass as a material to print upon is strongly recommended, especially with Mr. Simpson's process, as greater justice is done to negatives, and pictures of a higher order of beauty are yielded than can be produced on paper.

CABINET PORTRAITS.

THE success of the carte-de-visite has induced enterprising photographers to extend the idea; hence the "Cabinet" portraits. These may, in one sense, be considered as cartes of a large growth, but the size is improved in its proportions. The same treatment should be used in producing these pictures as in cartes—that is, as full-lengths, vignettes, &c., and with the usual accessories characteristic of indoor or outdoor scenery. A different lens will be necessary, as those used for the cartes are too short in focus. A half or whole-plate lens, or one made expressly, will answer best.

The adopted size of the cabinet portraits is as follows:—

Size of mounted picture	... $5\frac{1}{2}$ by 4
Mounting card	... $6\frac{1}{2}$ „ $4\frac{1}{4}$
Opening in album	... $5\frac{1}{4}$ „ $3\frac{7}{8}$

There can be but little doubt that, by united action, this size may become a standard one, especially as albums are constructed expressly for it. This new size, among its many

advantages, is well suited for portrait groups, interiors, landscapes, and many other subjects for which the dimension and proportion of the carte are quite unfitted. It will also afford a worthy opportunity for skilful photographers to break away from the little and petite effects that are of necessity peculiar to the carte size, and may lead the public to appreciate and desire larger pictures and better work, thus improving the art in every way.

HOW TO ARRANGE THE LENSES IN A PORTRAIT COMBINATION.

The lenses in a portrait combination are occasionally removed from their cells for the purpose of cleaning. Generally speaking, it is sufficient to unscrew the mounting, and wipe with chamois leather the two surfaces exposed. They can then be easily replaced; for the brass fittings are usually so made, that if by mistake the cells are screwed into the wrong places, the hood, or projecting shade, will not go on. The mistake is, therefore, easily detected and corrected. When, however, the lenses themselves are taken out of their cells—and, except for curiosity, this is rarely required, for the inner surfaces do not become dirty like the outer ones—the case is very different, for they may be variously transposed, and thus rendered incapable of producing good pictures. There is a risk also of breaking one of the glasses of the back lens in screwing it in, unless it be put together in the proper manner. Many good lenses have been condemned as hopelessly bad through being thus transposed.

In a portrait combination there are four lenses in all, the so-called *front* and *back* lenses being really each formed of a

pair. The front ones are always cemented together, and may thus be easily taken for one lens; the back pair are distinct, and are usually separated from each other by a narrow ring.

To place them in their proper positions, proceed as follows:—Take the front lens—the pair cemented together—and observe that one surface is considerably curved, and the other almost flat; place the lens in its cell, so that when screwed into the tube the curved side will be to the sitter. The two glasses forming the back lens are very unlike each other; one is thick at the centre and thin at the edge, the other thick at the edge and thin at the centre; put the thin-edged one first into the cell, resting on the least curved side; next put in the ring, and then the thick-edged glass, concave side towards the other lens; fix them in their places with the part provided, and screw the cell in its place.

With many portrait lenses there is an arrangement whereby the front lens may be used as a landscape lens; to use it for this purpose proceed as follows:—Unscrew the back lens and lay it aside altogether, as it is only required in the *double* combination; then remove the brass hood before the front lens; next unscrew the front lens, and rescrew it in the place where the back lens was. In doing this the *flat* surface will be presented to the object. The lens tube may be now put on the camera, and the central stops will be in their proper place for use. As the focus of the front lens, when thus used singly, is much longer than when used in combination with the back lens, the picture it will yield is proportionally larger, but a much smaller stop must be employed than when the lens is used for portraiture. The

exposure will be considerably greater than when the double combination lens is used.

The front lens will, of course, have to be put in its former place, and the back lens restored, to fit it for taking portraits.

THE AUTOTYPE PROCESS.

PRINTING BY MR. J. R. JOHNSON'S NEW CARBON PROCESS.

For several years past the carbon process has been steadily making progress, and for many kinds of work, reproductions of works of art especially, it has been successfully adopted instead of silver printing. Certain difficulties of manipulation have, however, prevented its taking the place of silver as the permanent printing process of the ordinary amateur, as well as of the professional portrait photographer. These difficulties have, however, been entirely surmounted by Mr. J. R. Johnson, and there is little doubt that silver printing will speedily be abandoned by all those who attach value to the permanency of their productions. The new process of Mr. Johnson—for such it really is—is exactly adapted to supply the place of albuminized paper, and silver, gold, and hypo solutions: the manipulations are really more simple than silver printing, and even less skill is required for producing prints by his method than by the usual silver one.

There are many carbon processes, but I confine my description entirely to Mr. Johnson's, as that is the one that is exactly adapted to the everyday wants of the ordinary photographer.

The most troublesome portion of any carbon process is

the proper preparation of what is called the *tissue*, that is, the sheet consisting of the layer of gelatine and carbon or pigment. So long as photographers had to prepare this for themselves no process could come into general use, but the Autotype Company, of which Mr. Johnson is one of the representatives, undertake to supply this tissue ready prepared, in a much more perfect manner than any one could prepare it for himself. This carbon tissue, or "pigmented paper," as Mr. Johnson prefers to call it, consists of a layer of gelatine containing the carbon or other permanent pigment spread on paper. As supplied it is not sensitive to light, but requires the action of a solution of bichromate of potash to render it sensitive. So far then the process resembles the silver printing one—the pigmented paper corresponding with albuminized paper, the bichromate sensitizing solution with the silver one. When the paper is dry, the pigmented surface is placed in contact with the negative and exposed to light, the exposure, however, should be considerably less, about one third the time required for silver printing. After this stage the operations in the two processes vary considerably. Perhaps the better method will be at once to go into practical details.

The pigmented paper is prepared in long rolls, so that much larger sheets can be obtained than of albuminized paper. It should be cut into convenient sized sheets for sensitizing. A solution, twenty grains to the ounce, of bichromate of potash is provided in a flat dish. The sheets may be placed in the solution one at a time until all are immersed. They should be turned over individually to see that no air bubbles form. They must remain in for not less than one minute, but may stay longer without injury. They should then be taken out,

and suspended to dry. This drying, with Mr. Johnson's patented tissue, may be expedited by heat, whereas in the former tissues the greatest difficulty used to be experienced in getting them dry, because heat instead of drying caused the gelatine to float off the paper. This serious trouble is quite removed now, and the tissue may speedily be dried by heat; it may even be laid before a fire to dry. This operation of sensitizing and drying must be done in chemical darkness, just like sensitizing silvered paper. Considerably more caution must, however, be taken, as the carbon paper is so much more sensitive; in fact, the operation had better be considered like the preparation of a dry collodion plate in the care necessary to keep it from light. When the paper is dry it must be placed in contact with the negative to be printed; but at this stage we enter on the new experience peculiar to the carbon process.

In silver printing it is very pleasant to watch the gradual formation of the image in the printing-frame as the silver darkens under the action of light. But with carbon we start with a dark paper, in which we can detect no such change, and therefore some other method must be adopted to know when our image is formed. Hence the process has been called a "blind" one. There is a foolish prejudice against this mode of printing because the image cannot be watched during its progress. In taking negatives, however, where the exact exposure is of far more consequence, the progress of the light cannot be observed, yet in practice operators do not make many mistakes. To give the correct exposure is the rule, and to make a mistake is the exception. In this instance there is nothing but judgment to guide the operator. But in carbon printing we really

have something else besides judgment—we have a substantial guide to literally show us what is going on, although we cannot examine our pigmented paper while it is being printed. The process is, therefore, not a blind one, but exactly the contrary.

It is the custom with many intelligent silver printers to classify their negatives according to their printing density, and to put out a batch of printing-frames together, and instead of watching each individual frame to watch one only, taking it as a type of the rest, and when it is printed sufficiently, to assume that all the rest are so also, and to take in the whole batch. That it is possible to thus accurately classify negatives is a certainty, for I know one gentleman who even goes so far as to cut up all his negatives to their exact required printing size and place them together in large frames holding a whole sheet of paper. If I were to mention this gentleman's name it would be universally admitted that he is one of the very best photographers living. He often prints more than 100 sheets of paper per day. Others I know who adopt a similar practice for the sake of economy. This gentleman does it by preference, for uniformity as well as for economy. It will be advisable then for carbon printers to thus classify their negatives. Let those negatives that print the quickest be called No. 1; those that require longer printing No. 2; and those still denser No. 3. Any amount of classification can of course be adopted, but these three gradations will suit nearly everybody.

Mr. Johnson has devised an "actinometer" to register the action of light during printing. Much has been said and written about actinometers. Practical men usually smile at them as being far too ingenious to be useful, and some of

these instruments, it must be admitted, are more like philosophical toys than photographic tools. Mr. Johnson's does not belong to this order. Any ignorant boy can understand and use it equally as well as the most intelligent man. It consists of a little round japanned tin box, with a slot in the lid about a quarter of an inch wide and an inch long, like a child's money box. Inside the box is a strip of Carrier's sensitized albuminized paper, about half an inch wide, coiled up in a roll. The lid of the box is painted a chocolate colour, like the tint that sensitized albuminized paper quickly takes when exposed to the light. By a simple means a portion of this paper is pulled out of the box, and in doing so a portion is exposed to light through the slot in the lid, the rest of the strip being screened from light. The paper when exposed begins to darken, and presently arrives at the same tint as that surrounding it on the lid of the box.

The principle of this actinometer is easily understood: it depends on the use of the permanently sensitized albuminized paper, and it measures the action of light by the period required to darken this paper to the standard colour—the chocolate tint painted on the lid of the box. When a strip of the paper is pulled through the box, the white sensitive paper is seen surrounded with the chocolate colour margin; it is then exposed to light, and when the previously white sensitive paper darkens to the same surrounding colour the actinometer should be stopped; the paper will then be said to have had "one tint," that is, it has been darkened to the standard chocolate tint that surrounds it. Let us suppose a negative to have sensitized pigmented paper placed under it, and the actinometer to have a piece of the white sensitive silver exposed through the slot, then let the actinometer and

the negative be both exposed simultaneously to the same light; by the time the light has darkened the silver paper to the standard tint, the actinometer and the negative will both be said to have received "one tint," that is, they will both have received that amount of action from the light necessary to produce on the silvered paper that particular tint. Of course a corresponding amount of chemical action will also have been produced on the pigmented paper under the negative. If subsequent action shows that that amount of exposure is sufficient for the carbon print, that negative will be called a "one tint" negative, because the amount of light required to produce the one tint on the silver paper is the same that is sufficient to produce a carbon print from it. For a denser negative, however, this exposure will not be enough. In that case, directly the silver paper has arrived at the standard tint it must be pulled through the box, and a fresh white portion be presented at the slot, and the exposure must be continued until this also has darkened to the standard tint. This negative will then have had exposure sufficient to produce two tinted portions of the silvered paper, and will therefore be called a "two tint" negative, and the pigment paper under it will have been exposed the time necessary to produce two tints on the silver paper. This tissue will therefore be said to have received "two tints," although in reality it has received no tints at all, for the action of light produces no change of colour whatever in it. The term "tint," then, in carbon printing, is a technical one, and means a measured amount of exposure to light corresponding to the time necessary to produce the standard chocolate colour on the albuminized paper in the actinometer. The term does not imply any change of colour what-

ever in the pigmented paper during the act of printing. I have spoken of negatives in relation to their density as requiring one or two tints, but some may require four or five, that is, they may require to be exposed the whole time continuously, while as many different portions of the sensitized paper in the actinometer have to be brought successively to those tints. In the first instance each negative, or each class of negative, will have to be tested by the actinometer, how many tints have to be darkened on its paper before the carbon print is made, and the negatives may then be marked accordingly.

After a negative has been once tried and marked the number of tints it requires, no mistakes will be made afterwards as to the exposure that will be required. With a very little experience a printer will tell with certainty, even without trial, by looking at the density of the negative how many tints to print. All this in description seems very elaborate, but in practice it is very simple and easy. By using Mr. Johnson's actinometer in this manner, the carbon printer can really see what he is doing, and he has not to rely on guess work or depend on judgment, and he can work with quite as much accuracy as the silver printer, especially as he has to make no allowance whatever by overprinting to make up for what the print loses in toning and fixing. There is some margin, also, by which the printer can manage in his after operations to compensate for a little over or under exposure.

We will suppose, then, that the proper number of tints is known for the tissue to be exposed to under any negative, and that the tissue has been thus exposed. The next operation is to attach the print to a temporary support during

the act of "development," or removal of the unacted-on pigmented gelatine. It may be as well here to allude to the change effected in the gelatine by the action of light. Plain gelatine we know is not sensitive to light, but is easily soluble in hot water. The bichromate of potash makes it sensitive to light, and the change effected in the gelatine by light is to deprive it of the property of being soluble in hot water. When the bichromated gelatine is exposed to light under a negative, the light acts on the gelatine through the transparent and semi-transparent parts of the negative, just as in silver printing it acts through them on the chloride of silver and albumen. The parts of the bichromated gelatine, then, that the light has acted on, are rendered insoluble in hot water, but the rest of the gelatine still remains soluble. The insoluble portion constitutes the picture, and our present business is to dissolve away everything but that which light has rendered insoluble. The print has to be attached for this purpose to a temporary support. Almost any substance impermeable by water will answer this purpose, but some are more convenient than others. If it were not for its expensiveness and fragility the surface of ground opal glass would be the model material to develop these prints upon; any one who wishes to follow this process luxuriously will use that substance. For ordinary use, however, Mr. Johnson provides zinc plates that have a finely ground surface. A plain surface does not seem to offer so good a means of attachment as one that is slightly roughened, which roughness communicates a tooth or bite. To prevent too great an attachment, and to permit ready removal afterwards, this roughened surface must be rubbed over with a dilute solution of wax and resin in turpentine. A little of this is

poured on the surface, and rubbed off again with a rag, leaving the merest film behind. The pigment print is then immersed in *cold* water, gelatine side downwards; the print first begins to curl inwards as the paper on the back expands with the water, but in a few seconds it flattens and shows signs of curling outwards; at this juncture take it out, and, previously wetting the glass or zinc that you are going to develop it on, lay it on gelatine side downwards, and with an india-rubber scraper, or "squeegee," press the print in close contact to the support, and expel the water under. Sweep the squeegee backwards and forwards once or twice to get rid of all the moisture that such pressure can drive out. Allow the print to thus remain for a few minutes—it may so remain for a considerable time if necessary, so that it does not become dry. If you have other prints ready to go on with, you may serve them all the same until you have several ready. After allowing the print a few minutes to absorb the moisture, you may, however, proceed, and when you examine the print you will be surprised to find how tightly it adheres to its support by atmospheric pressure. This is caused by the gelatine absorbing the water from the surface in contact with the support, thus creating a partial vacuum, on the principle of a boy's "sucker," or the attachment of a limpet to a rock. The pressure thus secured insures the perfect adhesion of the print to the surface of the support through all the subsequent hot and cold water washings. This is another of the many clever contrivances that the ingenious mind of Mr. Johnson has devised to make this process so thoroughly practical and simple. The glass or zinc with the print thus firmly attached by atmospheric pressure may now be immersed in hot water at the temperature of, say, 100 degrees Fahrenheit. Let it re-

main for a few minutes. When you see the coloured gelatine begin to show itself oozing from the edges of the paper, try one of the corners of the paper if it will lift easily ; if so, lift it slowly and steadily from the support, and it will come off, bringing with it a great deal of the unaltered pigmented gelatine. If it does not lift off easily, allow it to remain till it will do so. On no account must you force it up. The time it takes for the paper to come freely away depends on the temperature of the water it is immersed in. The water need not be hotter than the hands can bear ; a little patience will remove all difficulty. When the paper is removed the rest of the unaltered gelatine will speedily flow away, and the picture will gradually emerge from out of the dirty mess that surrounds and envelopes it. Allow it to remain in the hot water till all the soluble gelatine is removed ; this you will know by the ceasing of the slightly dirty or coloured streams that previously have come from the picture. There is no fear of the print itself being dissolved away, for the altered gelatine that forms it is insoluble. When all that will come away has come away, the glass may be removed from the warm water, and be well washed in cold water, and the picture may then be set aside to dry, still adhering to the glass or zinc. This removal of the unacted-on coloured gelatine is called "development," but the operation resembles more the fixing a negative after development by dissolving in the hypo the unacted-on iodide of silver. When the print is in this state it can easily be seen if the exposure to light under the negative has been too little or too much. If it has been too little the print will be too light, that is, there will not be enough pigmented gelatine left on the glass to properly represent

the negative. In other words, sufficient time was not given for the light to render enough of the gelatine insoluble. The print will betray the deficiency of exposure by the absence of the half tones. If, however, the print is too dark—looks dirty in the high lights and half tones—then the exposure has been too great, and too much of the gelatine has been rendered insoluble. If either error has been committed a mark should be made on the margin of the negative showing the greater or lesser number of tints that the negative should receive in future printings. Do not be alarmed at the print looking muzzy and indistinct, as if it had not been pressed in close contact in the printing-frame. The gelatine prints never look sharp when they are wet; they will be sharp enough when the gelatine is hard and dry.

We will suppose, however, that the print is neither too light nor too dark, and that the correct exposure has been given; after the print is dry we will proceed to the next operation—transferring it on to the permanent paper base to which it is to remain. Many persons who have been successful through all the stages up to this point, have failed in the final transferring through not availing themselves of that which Mr. Johnson has so thoughtfully provided—a proper transfer paper. Ordinary plain paper, or even paper slightly gelatinized is not sufficient for finally attaching to the image on the glass or zinc. If such papers be attached to the gelatine image the finer parts of the high lights and half tones are so attenuated that this kind of paper will be sure to leave them behind. Mr. Johnson has, however, provided a paper with a coating of insoluble gelatine that readily attaches itself and incorporates itself with the image, and brings it all

off the glass perfectly, if the proper instructions are obeyed. Pour boiling water in a flat dish and immerse the transfer paper supplied by the Autotype Company; many sheets may be immersed at a time. One side of the paper will be found to be covered with a gelatinous layer that softens but is not soluble in even boiling water. Allow it to remain in the hot water until it thoroughly softens and becomes quite soft, slimy, and pulpy. When it has arrived at this condition, and not before, lay it on the image on the glass or zinc, and with the squeegee smooth it down so as to be in close contact, and, by stroking the paper, expel superfluous moisture. Allow the paper to dry. When thoroughly dry the paper may be stripped from the glass, bringing the print with it. I say *thoroughly* dry, because it will not leave the glass perfectly unless it is quite dry. In some cases it will come off spontaneously, but usually it may be started at the corners and will come off freely. Sometimes it may be dry at the corners and damp in the middle; you must wait till it is quite dry all over, as it will not be forced. Occasionally it may happen that even when it is quite dry it will not freely come away; a little heat may then be applied to the glass, and the print will almost fly off. In such instances there has been rather too much resin in the waxing solution that was applied to the support: remedy, add a little more wax. If on the other hand there be too much wax and not enough resin, the print will come away too easily before it is even quite dry. The happy medium is when, quite dry, it will easily come off by starting one of the corners. A little turpentine or benzole should be rubbed over the surface of the print, to remove any of the wax and resin that may show on the face. In every stage of the process many prints

may be carried on simultaneously, thus economizing time and doing the work more perfectly, because less hurriedly. This particularly applies to the development. For this purpose Mr. Johnson has contrived an ingenious metal box to hold hot water while developing. This box has a spirit lamp—or a jet of gas may be attached—to keep up the temperature of the water. A thermometer is also provided to estimate the temperature. In this box are also grooves to suit the size of the plates employed, and during development many of the plates may be developing at the same time, each securely placed in its own groove. Prints rather under-exposed may be got through quickly, and others rather over-exposed may have longer time and higher temperature applied.

If the prints are considered too dull, increased glaze may be given—thereby increasing the brilliancy—by the use of varnish, collodion, or other glazing materials. This may be done before the pictures are finally mounted on cardboard, or afterwards.

There is one special point that is of imperative importance in carbon printing by Mr. Johnson's process—the edges of the pigmented paper must never be exposed to light. It is quite a usual thing in silver printing to see the bronzed margin of the paper extend beyond the negative. This must never be permitted in carbon printing. It is not sufficient that the carbon paper is smaller than the negative, but all around the margin of the negative a band of dark paper, or black varnish, must be put to protect from light for a quarter of an inch the edges of the pigmented paper. This margin of unacted on paper all round is technically known as the "safe edge;" an excellent name it is, as it denotes its usefulness.

The utility of this safe edge is to provide a margin of unacted on gelatine all around the print, by which the attachment is secured to the support during development. When light acts on the gelatine and renders it insoluble, it also destroys its sucker-like character and prevents the adhesion by atmospheric pressure. Hence the water gets between the film and the support and breaks up the image during development. If the margin of the print has been protected from light it retains this adhesive property, and thus the whole print is securely attached by the edges, and the water cannot get between the film and the support but can only act on the face of the print. Unless this precaution be adopted of providing for a safe edge by protecting from light the extreme edges of the paper, development cannot be conducted with safety.

There is a method of working by which the pigmented tissue is attached at once after coming from the printing-frame, on to paper, instead of to a temporary support; when development is finished the picture is complete without any further transferring. This is called working by the "single transfer." The prints so produced are however all *reversed;* it is necessary therefore in working by this method to either take reversed negatives in the camera, or to strip the negatives off the glass so as to use them from the contrary side.

In principle the "single transfer" appears to be the proper mode of working, but in practice it will be found that the double transfer, though apparently more roundabout, is the best in the end.

It will be seen that the entire principle of this printing process depends on obtaining an image in insoluble gelatine,

and the colour of the image will chiefly depend on the colouring substance, or pigment, that is held imprisoned in the insoluble image. Hence any colour may be mixed with the gelatine originally, and images may be obtained of every hue of the painter's palette. When I speak of the image being formed of *insoluble gelatine*, I speak incorrectly; there is no such thing as insoluble gelatine: directly it becomes insoluble it ceases to be gelatine. Light and bichromate of potash change what was once gelatine into another and more stable substance, partaking, in its new properties, more of the nature of vellum.

It is not necessary to repeat here the many sufficient reasons to establish the durability of prints produced by this method. The chief purpose now aimed at is to bear testimony to the thoroughly practical character of the new process. For a full description of the principle on which all carbon and pigment printing is based, and the steady development of this method of producing permanent photographs, the reader is referred to the interesting work by Mr. G. Wharton Simpson, entitled, "On the Production of Photographs in Pigments," and to the handbook published by the Autotype Company, in which will be found the amplest details of this invaluble process.

My purpose in this article has been to show that now at least the production of permanent works in photography is brought within the reach of the humblest photographer. It only remains for photographers to avail themselves of the labours of the many minds who have laboured at this great work — permanent printing, the climax of which has been reached in this last patented process of Mr. J. R. Johnson.

MAXIMS AND MEMORANDA.

When working away from home, be sure to take everything with you, and never rely upon what you can get "there." Besides, you save time, and do your work so much better. It is provoking to find you have brought everything but the dipper, or the ground-glass, or the dark slide.

Double or treble the exposure in the camera is required during an easterly wind.

Examine, and if necessary re-yellow, the window of the dark-room in the spring of the year. The chemical obstruction sufficient for winter is quite inadequate for the spring and summer.

To take quick pictures, practise cleanliness. Clean lenses, clean camera, clean windows, clean glasses, clean chemicals, clear air, and a clear head, are all necessary in working quickly.

Keep your apparatus all in good order. Do not put them away with anything defective. Nothing can be depended on if there is a screw loose anywhere.

Avoid the use of wide-angle lenses when the ordinary ones will do. They are dangerous tools to use.

Extremes of heat and cold are not good for the photographer or his chemicals. In the hot weather they are difficult to control from their exuberant activity; in cold weather they are sluggish and torpid, and lose half their power. Moral: avoid extremes. Keep your camera, your chemicals, and yourself, cool in summer and warm in winter. Both you and they will work all the better with an equable temper and temperature.

THE END.